CIVIL ENGINEERING

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

1852 CENTENNIAL of ENGINEERING 1952

• CONVENTION PROGRAM—Chicago, Illinois, September 3-13, 1952 •

completed

...another bridge on RAYMOND piles

Constructed for State of California Department of Public Works, Division of Highways.

spanning the South Channel Sweetwater River between National City and Chula Vista, California is this 332-foot long highway bridge supported by Raymond piles. It has a 28-foot wide roadway and is of reinforced concrete construction with concrete caps resting directly on the Raymond piles—another example of the important role Raymond is playing in the constant development of the highways of America.

THE SCOPE OF RAYMOND'S ACTIVITIES . . .

Foundation Construction . . . Harbor and Waterfront Improvements . . . Soil Investigations . . . In-Place Pipe Lining . . . Specialized Construction

RAYMOND
CONCRETE PILE CO.
140 Cedar Street • New York 6, N. Y.

Branch Offices in the Principal Cities of United States and Central and South America.

AROUND THE WORLD · FOUNDED 1897 ·

Barber-
Mixall
Greene
MODEL 804

...THE NEW B-G Mixall

MIXES ALL THE HOT PATCH YOU NEED,
ANY TIME, ANYWHERE, ANY WEATHER

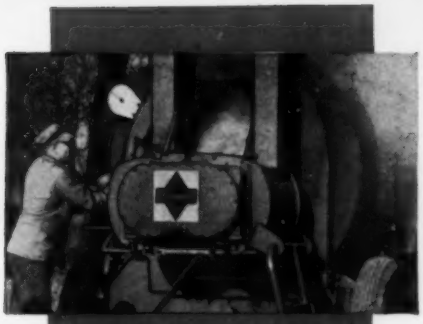
Now, the new Barber-Greene Mixall gives you the opportunity to offer high quality bituminous paving for driveways, sidewalks, service stations, industrial plants, parking lots . . . and other "black top" jobs at new low costs.

The Mixall, a completely new, compact and portable small-job maintenance and paving mixer, will produce up to 5 t.p.h. of any type hot mix . . . up to 10 t.p.h. of cold mix . . . will produce low slump Portland cement mixes. Built to be towed behind the aggregate truck for on-the-spot mixing, the Mixall is just as well suited for central plant or stock pile operation. The Mixall can work in any weather . . . even drying frozen aggregates.

Think of what you could do with the new B-G Mixall in your territory. Then see the Mixall at your first opportunity . . . or write for full information.

THE ONLY SMALL JOB MAINTENANCE MIXER WITH...

- ROTARY DRUM DRYING: The same principle used in largest B-G Continuous Dryers.
- TWIN SHAFT HEATED PUGMILL: "Kneading" action assures even coating of every aggregate particle.
- POWER SKIP HOIST: Only 14" high for easy charging.
- HIGH DISCHARGE: Can discharge directly into place, into wheelbarrows or gas buggies.



For parking lots, factory floors . . . on-the-job drying of aggregates, complete control of mix.

For playgrounds, tennis courts, roads and streets . . . scattered jobs . . . variations of mixes.

No setup time with Mixall. Operate it hitched to truck for drives, sidewalks, other small jobs.

"Stitch-in-time" maintenance prevents major break-ups; the Mixall works in any weather.

Resurfacing busy crossings, Mixall's compactness allows minimum traffic interference.

BARBER-GREENE COMPANY

AURORA, ILLINOIS

CIVIL ENGINEERING, The Magazine of Engineered Construction, August, 1952. Vol. 22, No. 8. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Monotubes put "crippled" building back on its feet!

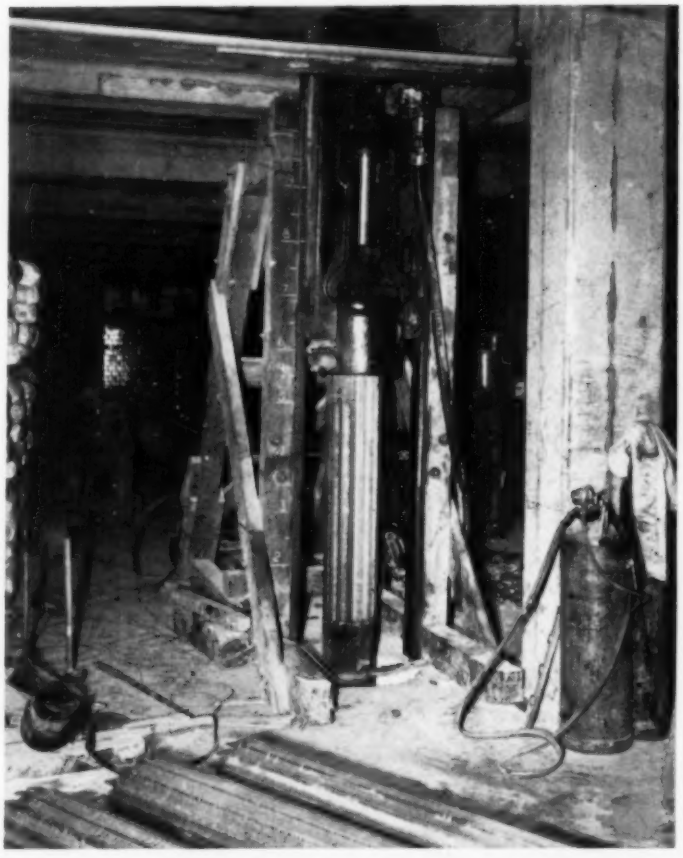
Severe cracking of building wall due to differential settlement.

DOING unusual foundation jobs, even with low headroom, is often the *usual* task for Monotube steel piles. For example, the building pictured here became badly cracked due to differential settlement. The condition had to be corrected—permanently!

Providing proper underpinning *and* licking the low headroom problem was easy with Monotube piles. Short, 6-foot lengths were driven easily; extensions were quickly weld-spliced as needed to reach good soil at 65 to 70 foot depths.

Monotubes have advantages that help solve problems in all kinds of foundation construction—from turnpikes, bridges and skyscrapers, to jobs like the one pictured here. Monotubes, cold-rolled for high strength, offer exceptional rigidity and high structural value. They come in lengths, gauges, tapers and sizes for varying soil conditions.

Send for the complete story. Find out how Monotube steel piles can simplify foundation work and cure construction "headaches", at minimum cost *and* in minimum time. Write to The Union Metal Manufacturing Company, Canton 5, Ohio.



Close-up of Monotube pile being driven in 6-foot sections. Installation by The Purdy Construction Company, Mansfield, Ohio.

UNION METAL

Monotube Foundation Piles

Leffel

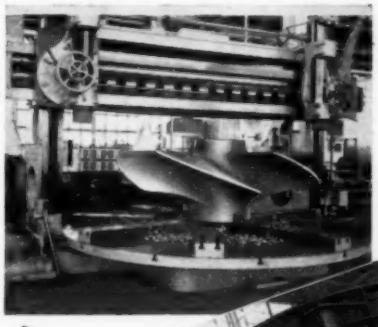
HYDRAULIC TURBINE

increases

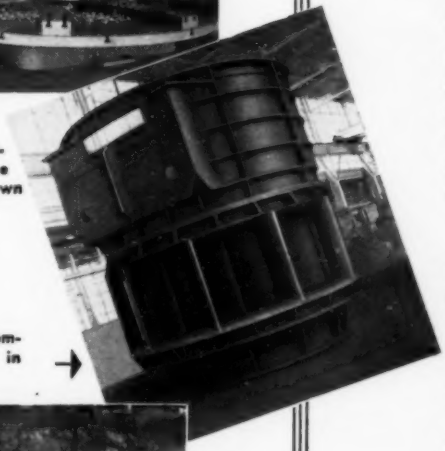
power output at

WILBUR DAM

of the Tennessee Valley Authority



Cast steel propeller-type runner for the Wilbur turbine, shown on boring mill.

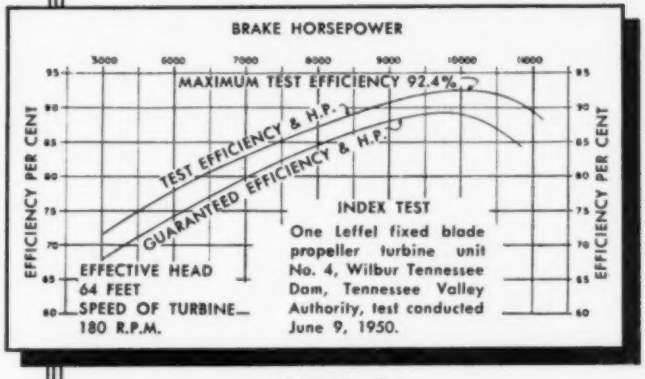


Wilbur turbine, completely assembled in the Leffel plant.

Lifting the combined runner, shaft and cover-plate during the field installation.

The Wilbur power project of the TVA is another instance where a Leffel hydraulic turbine was used for the expansion of existing power facilities. For the Wilbur installation a Leffel vertical propeller-type hydraulic turbine was used — maximum rated at 11,500 HP, under 67 feet net head, speed 180 RPM.

The Wilbur project demonstrates once again that the long-range economy and dependability of Leffel turbines make a valuable asset for any expansion or rehabilitation. Our facilities are backed by 90 years of reliable service to the water power industry. Why not let us help you with your project, whether it be expansion, rehabilitation or a new installation?



Field Test Results

1082

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 90 YEARS

Monotubes put "crippled" building back on its feet!

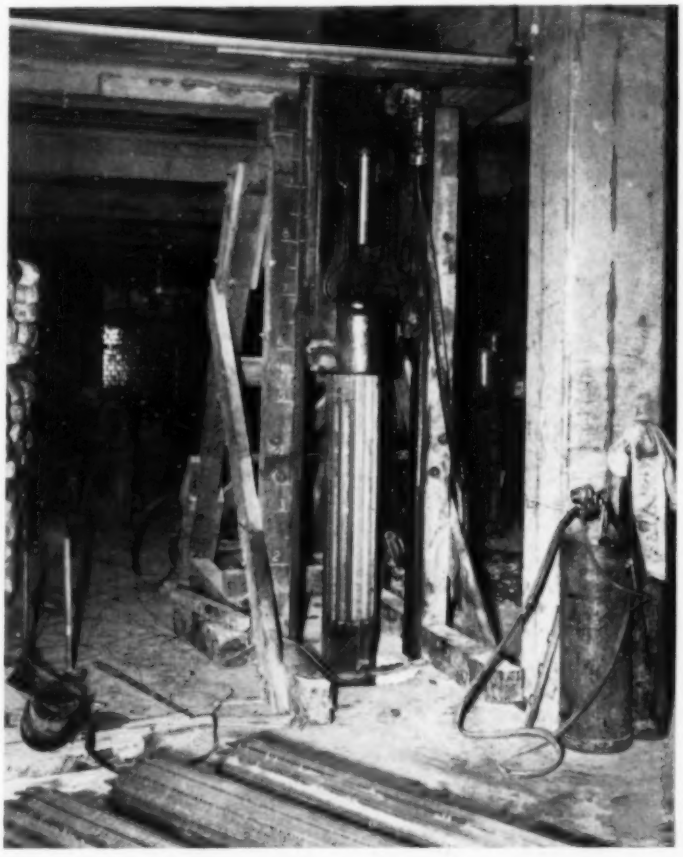
Severe cracking of building wall due to differential settlement.

DOING unusual foundation jobs, even with low headroom, is often the *usual* task for Monotube steel piles. For example, the building pictured here became badly cracked due to differential settlement. The condition had to be corrected—permanently!

Providing proper underpinning *and* licking the low headroom problem was easy with Monotube piles. Short, 6-foot lengths were driven easily; extensions were quickly weld-spliced as needed to reach good soil at 65 to 70 foot depths.

Monotubes have advantages that help solve problems in all kinds of foundation construction—from turnpikes, bridges and skyscrapers, to jobs like the one pictured here. Monotubes, cold-rolled for high strength, offer exceptional rigidity and high structural value. They come in lengths, gauges, tapers and sizes for varying soil conditions.

Send for the complete story. Find out how Monotube steel piles can simplify foundation work and cure construction "headaches", at minimum cost *and* in minimum time. Write to The Union Metal Manufacturing Company, Canton 5, Ohio.



Close-up of Monotube pile being driven in 6-foot sections. Installation by The Purdy Construction Company, Mansfield, Ohio.

UNION METAL

Monotube Foundation Piles

Leffel

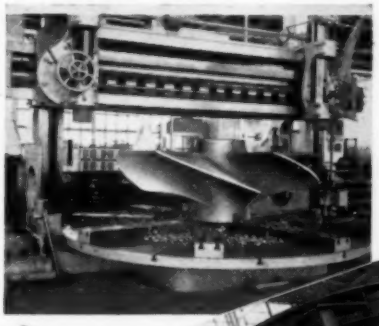
HYDRAULIC TURBINE

increases

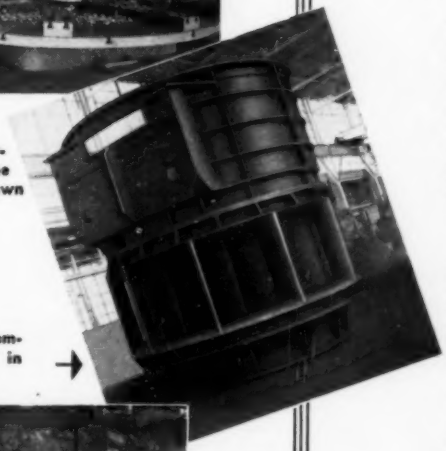
power output at

WILBUR DAM

of the Tennessee Valley Authority



Cast steel propeller-type runner for the Wilbur turbine, shown on boring mill.

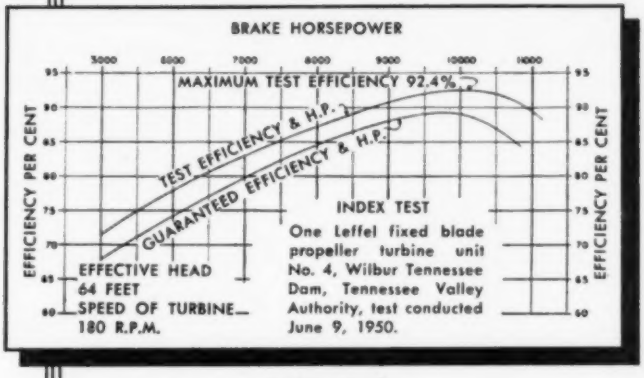


Wilbur turbine, completely assembled in the Leffel plant.

Lifting the combined runner, shaft and cover-plate during the field installation.

The Wilbur power project of the TVA is another instance where a Leffel hydraulic turbine was used for the expansion of existing power facilities. For the Wilbur installation a Leffel vertical propeller-type hydraulic turbine was used — maximum rated at 11,500 HP, under 67 feet net head, speed 180 RPM.

The Wilbur project demonstrates once again that the long-range economy and dependability of Leffel turbines make a valuable asset for any expansion or rehabilitation. Our facilities are backed by 90 years of reliable service to the water power industry. Why not let us help you with your project, whether it be expansion, rehabilitation or a new installation?



Field Test Results

1082

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 90 YEARS

Why cast iron pipe

can and does save

Millions of Tax Dollars

The answer, of course, is (1) cast iron pipe serves for centuries, and (2) over 95% of the pipe in service in America's water distribution systems is cast iron pipe. But let's get down to figures.

The cumulative cost of our water supply systems, from 1817 to 1951, is estimated at $6-billion, of which more than $3.5-billion is for cast iron pipe, including installation costs. The balance is for pumping stations, filter plants, storage facilities, etc.

Most of this money was raised by the issuance of bonds. Now, the useful life of cast iron pipe is at least 4 to 5 times the average term of a water revenue bond issue. Records prove that more than 35 American cities have cast iron mains in service that were installed over 100 years ago. A survey sponsored by three waterworks associations shows that 96% of all six-inch and larger cast iron pipe *ever laid* in 25 representative cities is still in service.

Add it all up and the answer is clear that, by serving for generations after bonds issued to pay for them have been retired and forgotten, cast iron mains save many millions of tax dollars.

One of a number of cast iron water mains which have been in service in New York City for more than a century. Over 35 other cities have century-old cast iron mains in service.

CAST IRON ®

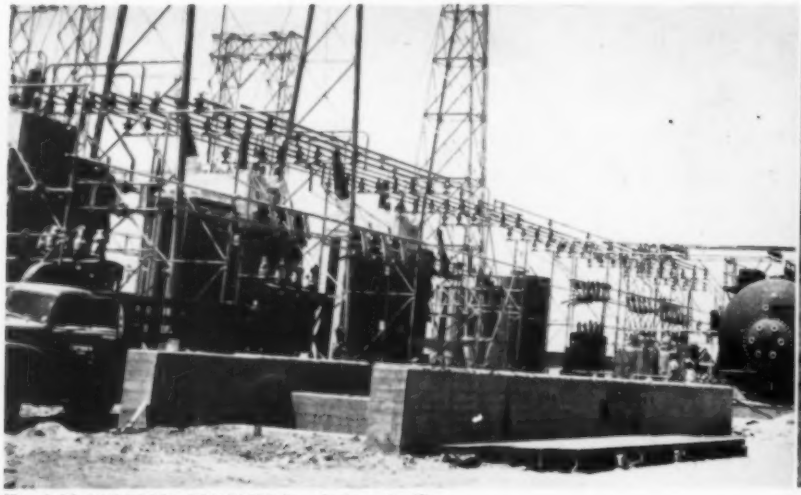
CAST IRON PIPE

America's No.1 Tax Saver

©1952, Cast Iron Pipe Research Association

CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

Hydropel Integrally Waterproofs Concrete Best in Competitive Tests



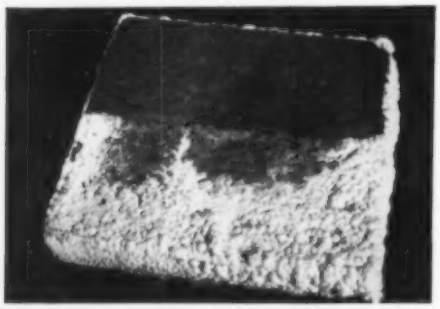
(Top left) **HYDROPEL CONCRETE foundations, Pacific Gas & Electric Company—Midway Steam Plant.**

(Top right) **PLAIN CONCRETE in same location—showing effect of alkali soils.**

PRODUCT	% CAPILLARY ABSORPTION*
ADDITIVE A	8.93
ADDITIVE B	10.60
ADDITIVE C	8.05
ADDITIVE D	8.75
ADDITIVE E	10.19
ADDITIVE F	6.06
ADDITIVE H	10.23
PLAIN CONCRETE (5½ sack)	8.10
AIR ENTRAINED CONCRETE (5½ sack)	7.80
HYDROPEL (5½ sack)	**1.09**

**2" x 4" Cylinder of minus 3/8" material, specimens dry at 140° F.*

TEST RESULTS as tabulated by Pittsburgh Testing Laboratory show comparative capillary water absorption after seven days.



HYDROPEL BLOCK *(top half)* **absorbed little of the salt solution in which it was placed till all had evaporated. Air-entrained concrete** *(lower half)* **sucked up the solution, leaving destructive salt crystals throughout.**

OF ALL WATERPROOFING PRODUCTS, Hydropel® integral admix for concrete ranks highest. Pittsburgh Testing Laboratory proved this in exhaustive tests. Concrete treated with eight major competitive products actually absorbed from five to ten times more moisture than Hydropel-treated concrete. The Pittsburgh technicians also proved Hydropel accomplishes waterproofing *without loss of strength.*

All types of construction benefit:

PAVING ENGINEERS—can build concrete pavements without destructive volume changes due to moisture.

ARCHITECTS—can specify—and get—basement concrete that remains warm and dry—assuring owner-satisfaction.

INDUSTRIAL PLANTS—can have concrete that lasts 4 times longer in bad alkali and moisture conditions.

CONTRACTORS—can, at last, deliver quality concrete for tough places at low premium cost.

Send for free illustrated descriptive booklet

HYDROPEL®

AMERICAN BITUMULS & ASPHALT COMPANY • 200 BUSH STREET, SAN FRANCISCO 4

MONO-CAST Pipe for Every Service Condition

"Mono-Cast" is the trade name for ACIPCO pipe cast centrifugally in sand-lined molds. Uniform metal section, high physical strength, endurance, and freedom from inclusions are salient properties which have established the name "Mono-Cast" as synonymous with highest quality cast iron pipe. It can be supplied with joints for conveying water, gas, oil, gasoline, sewage, salt brine, ashes—and in fact, just about everything that a pipe line can conceivably convey.

Being cast iron, Mono-Cast Pipe enjoys an enviable reputation. Cast iron pipe has had over three hundred years of service abroad and more than one hundred years of service in the United States. It is satisfactorily serving in locations where especially severe external and internal corrosion conditions exist. Mono-Cast Pipe is designed to give super-service; and its wide acceptance and splendid performance bespeak its excellence and the confidence and esteem in which it is held by those who are using it.

Since the beginning of our Company nearly half a century ago, ACIPCO has constantly worked hand-in-hand with engineers, contractors and superintendents in solving piping problems in their respective fields. Refer your next piping job to ACIPCO, and utilize the extensive manufacturing facilities of the largest individual cast iron pipe foundry in America. Let us assist you by taking off lists of material and submitting a price on pipe and fittings for your next job.

Write for free literature, stating the kind of joint in which you are interested. Address the ACIPCO office nearest you.

AMERICAN CAST IRON PIPE COMPANY

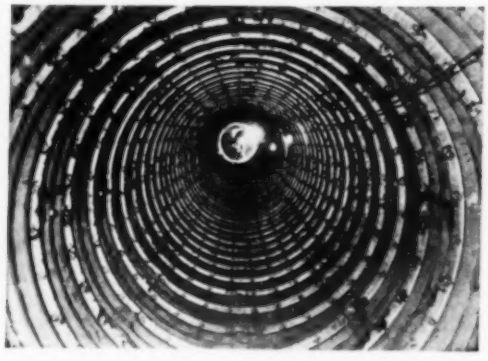
BIRMINGHAM 2, ALABAMA

Dallas	**Houston**	**El Paso**	**Pittsburgh**	**Kansas City**	**New York City**
Chicago	**Minneapolis**	**Cleveland**	**Los Angeles**	**San Francisco**	**Seattle**

It's a simple step

from THIS

to THIS



The simple, economical way to keep underground structures underground is to do the job with Armco Liner Plates. Then surface installations are not torn up nor traffic disrupted. You save time, money and trouble.

With Armco Plates the job moves quickly. No costly delays because of bad weather and no replacement of expensive pavements.

Tunneling with Liner Plates is simple. Strong but light in weight, they are easy to handle and install. An unskilled workman can carry, hold and bolt a section into place using only a structural wrench. Job costs are low.

Besides economy, Armco Liner Plates assure strong, safe structures. Corrugated metal design means utmost strength with minimum weight and bulk. The corrugations extend through the longitudinal lapped joints to provide a completed ring of uniform strength.

You'll like the convenience and efficiency of Armco Liner Plates for underpasses, sewer and utility line conduits, tunnels and similar underground structures. Write for data. Armco Drainage & Metal Products, Inc., 4032 Curtis St., Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

Armco Liner Plates

ARMCO

Storm sewer construction in winter weather

Three contractors team up "Caterpillar" equipment to push through Denver job

For a new housing development near the Denver, Colorado, Airport, two miles of deep storm sewer had to be laid during the coldest months of the past winter. Three contractors, Horn's Crane Service, Thomas Bate & Sons and C. L. Hubner Co., all of Denver, had the job. Pooling their equipment they completed the contract on schedule in spite of severe frost conditions, caving sand and high winds.

The trench was 20 feet deep, and wide enough for 72-inch lock-joint concrete pipe. It was dug by a Bucyrus-Erie Model 38B backhoe with 1¾-yard bucket and a Manitowoc Speedcrane dragline, also with 1¾-yard capacity.

This photo, taken in January, 1952, shows teamwork between the Bucyrus-Erie backhoe, owned by Horn's Crane Service, and the Manitowoc Speedcrane, owned by Thomas Bate & Sons. Both units are powered by "Cat" D13000 Engines.

A "Caterpillar" Diesel D8 Tractor and No. 8S 'Dozer, owned by C. L. Hubner Co., backfills the trench after sewer pipe is laid.

Each machine was powered by a "Cat" Diesel D13000 Engine. The backhoe was used for roughing out, while the dragline finished the trench. Another Speedcrane handled the pipe.

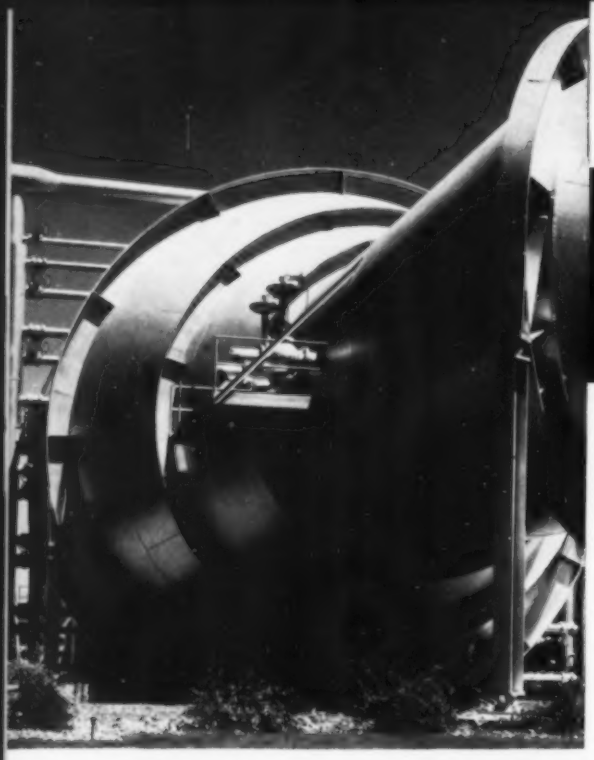
When it came to backfilling the trench, a "Caterpillar" Diesel D8 Tractor with a No. 8S Bulldozer did the job.

No profit in down-time

Experienced construction men know that to make money on a contract they have to keep their equipment working. Down-time for service or repairs boosts costs and cuts profit. Especially where conditions are difficult, dependable machinery pays off.

Standardizing on "Caterpillar"-powered equipment is one way to assure steady production. Every "Cat" Engine is built to deliver its full rated horsepower, and its simplicity of design contributes to long, reliable work life. Backing it up is the efficient service of a thoroughly equipped dealer organization. The "Caterpillar" line includes twelve engine sizes, ranging from 52 to 500 HP, available for original or replacement use in practically every type of excavating and earthmoving equipment. It will pay you to get the full story from your "Caterpillar" Dealer.

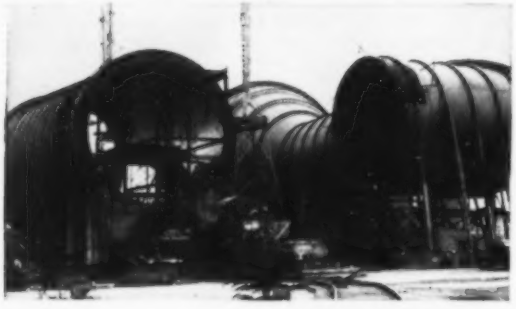
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

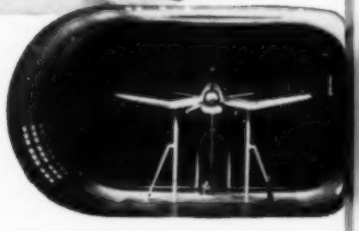


WIND TUNNEL CONSTRUCTION

DEVELOPMENT
ENGINEERING
and DESIGN

PITTSBURGH •DES MOINES





Pittsburgh-Des Moines' leading role in engineering and constructing the great majority of Wind Tunnels for the advancement of American aviation and ordnance research typifies the unusual resources of this Company in executing the most difficult platework projects. In research, design, fabrication and erection, Pittsburgh-Des Moines offers wide experience, complete facilities, undivided responsibility. • Write for our descriptive Company brochure.

PITTSBURGH•DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) . . . . . 3470 Neville Island
NEWARK (2) . . . 251 Industrial Office Bldg.
CHICAGO (3), 1274 First National Bank Bldg.
LOS ANGELES (48), ... 6399 Wilshire Blvd.
DES MOINES (8), 971 Tuttle Street
DALLAS (1), 1275 Praetorian Bldg.
SEATTLE . . . . . 578 Lane Street
SANTA CLARA, CAL., 677 Alviso Road

Here's a Boom That REACHES For Extra Jobs

The Bucyrus-Erie 3-ton Hydrocrane with hydraulically telescoping boom reaches into windows and box cars . . . over fences . . . under beams and overhanging branches . . . between wires and rafters — without moving crane an inch! Boom extends and retracts a distance of eight feet.

The outstanding advantages of telescoping boom plus precision hydraulic control combine to make the Hydrocrane ideal for handling forms . . . pouring concrete . . . moving materials—setting steel, concrete slabs, wooden rafters — dozens of jobs.

Here is the made-to-order crane for in-between jobs — work that shouldn't tie up expensive heavy equipment, yet is too big for hand labor. Get full details. Write today for descriptive literature or see your Hydrocrane distributor. 151H52

- **Sure-Footed** — outriggers extend or retract hydraulically in seconds.
- **Speedy** — 50 mph. top highway speed.
- **Squeeze-in Specialist** — shortest tail swing of any crane, size for size.
- **"Dead Man" Control** — if operator lets go of levers, load stops dead.
- **Velvet Smooth** — all work functions powered by a cushion action hydraulic system.

● Every crane function fully hydraulic — boom hoist, load hoist, swing, boom telescope, outrigger set and retract, bucket close. Available with quickly interchangeable drag-shovel front-end.

BUCYRUS-ERIE HYDROCRANE DIVISION · South Milwaukee, Wisconsin

"Dirt-movin'est tractor I ever saw!"

BIG RED CHAMPS! The TD-24s with 148 drawbar horsepower do more work per day—they have more horsepower and speed than any other crawler on the market. And they have Planet Power Steering, for pivot-turns, feathered-turns or turns with power on both tracks!

Big Red TD-24s distinguish themselves building levees to control Missouri River

Near St. Charles on the Missouri River, the levees failed against the flood of '51. But Paul Crawley rebuilt them so they stood firm against the worst the river could do in 1952.

Crawley's contract called for moving 940,000 cubic yards of dirt. A big job, a tough job, in the bitter dead of winter. And for Crawley's money, the International TD-24s proved to be real Champs.

"They're the dirt-movin'est tractors I ever saw," he reports. "There's no other crawler to compare with 'em for daily work production!

"They climbed the levee with full loads with no special ramps of any sort. They'd dump their loads, turn around on the 8-foot crown and go back down for another load. It was work that called for superior power and steering, and my TD-24s had it!"

Get the low-down on TD-24 performance from your International Industrial Distributor. You'll be a TD-24 man yourself from then on in!

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

GOVERNMENT INSPECTOR, George Lemp, talks it over with prime contractor Paul Crawley (right).

CRAWLEY'S CRAWLERS did the job in a sea of winter mud that froze from time to time.

INTERNATIONAL HARVESTER

INTERNATIONAL

POWER THAT PAYS

Transite Pipe is a product of modern engineering and research. Shown above is one of the buildings at the Johns-Manville Research Center at Manville, New Jersey.

*Transite is a registered Johns-Manville trade mark

Johns-Manville TRANSITE

TRANSITE PIPE last longer California city streets?

Transite Pipe was first installed by this California city nearly 20 years ago. Its lasting strength and high corrosion resistance have enabled it to outlast pipe previously used several times over.

Research designed it for lasting strength

TODAY, ACROSS THE COUNTRY—under countless city streets like the one shown above—Transite® Pressure Pipe is doing a highly efficient job of transporting water . . . often under conditions so adverse to ordinary pipe that engineers marvel at Transite's ability to stand up through the years!

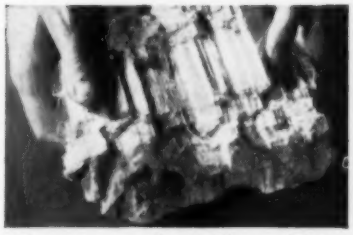
The reason? *Lasting strength!*

Not only does Transite Pipe have the *initial* strength that's needed in a pipe intended for use under busy city streets. Equally important, it has the *lasting* strength that enables it to survive continued corrosive attack, year after year . . . to keep on giving the same dependable, economical service to the community as the day it was installed.

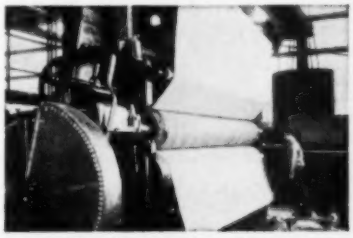
This highly important quality of lasting strength is one of many notable inherent advantages of a pipe engineered with modern water transportation requirements in mind. Transite's Simplex Couplings reduce leakage losses to a minimum, provide flexibility to help relieve the line of soil stresses and traffic loads. Its light weight makes for easier handling and effects substantial savings during installation. Its smooth interior assures a high coefficient of flow (C=140) and, because Transite can never tuberculate, helps keep pumping costs low through the years.

Why not get all the details . . . find out how this modern-engineered-for-the-job asbestos-cement pipe can help solve your water-line problems and *save you money?* For full information, write Johns-Manville, Box 60, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS



Tough, strong asbestos fibers reinforce Transite Pipe—contribute to its high corrosion resistance and lasting strength.



On machines like this, the asbestos-cement-silica mixture is "built up" under heavy pressure into a dense, homogeneous pipe structure.

Transite's flexible Simplex Couplings help relieve the line of excessive flexural stresses—an added safeguard against pipe failures.

asbestos-cement PRESSURE PIPE

What every highway engineer should know about the Maryland Test Road

Not a single structural crack developed in any of the 28 forty-foot concrete slabs built on non-pumping, granular subbase

The Maryland Test Road, 1.1 miles long on U. S. 301, was a two-lane concrete pavement of 9″–7″–9″ section. When it was built in 1941 pumping had not become a problem. Consequently most of the concrete pavement was placed directly on the natural fine-grained subgrade. However there was a non-pumping, granular subbase under 28 forty-foot slabs.

For nine years the pavement in this test section carried all normal traffic *plus* the heavy wartime traffic. Then for six months the pavement was subjected to accelerated truck traffic equivalent to at least 20 years of normal traffic on this road. Yet the 28 slabs on granular subbase carried 238,000 trips by trucks with single axle loads of 18,000 lb. in one section and 22,400 lb. in another section without any structural cracks. These slabs are in as good condition as when opened to traffic.

Since the Maryland Test Road was built a decade ago there have been many improvements in concrete pavement design and construction. With today's knowledge of soils, highway engineers can determine subgrade bearing values and any tendency of soils to pump. A thin insulating layer of granular material, where needed, will prevent pumping.

Thus the engineer can design a concrete pavement that will give unexcelled service under an unlimited number of legal axle loads and render this service at **lower annual cost** *than any other pavement.*

PORTLAND CEMENT ASSOCIATION
33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS
A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

OUR THANKS TO YOU...

Open Steel Flooring Institute, Inc.

On this day of March 11, 1952, we, the members of this Institute, do hereby present this scroll to

Walter E. Irving

Founder of the Open Steel Flooring Industry

Without his vision, resourcefulness and perseverance, the industry, as constituted today, may never have come into being.

We honor him for his pioneering and leadership and for his devotion during the past half century to an idea and an ideal.

Walter E. Irving first conceived of open mesh steel grating as the perfect flooring to walk on, to work on and to wheel on. He did more to make this a reality than any other one man.

These words express only in small part our respect, admiration and gratitude to the Father of Our Industry.

Vice President

Secretary

WE WISH TO OFFER OUR THANKS TO THE MEMBERS OF THE
OPEN STEEL FLOORING INDUSTRY
FOR THE SIGNAL HONOR BESTOWED UPON OUR FOUNDER
WALTER E. IRVING
ON THIS OUR
GOLDEN ANNIVERSARY
IRVING SUBWAY GRATING CO., INC.
LONG ISLAND CITY 1, N. Y. OAKLAND 20, CALIF.

Layne's new all color and sound motion picture "DEEP WATER" brings to the screen a dramatic story of how Layne builds the world's finest water supply wells and pumps. For details on booking this picture for a showing without cost or obligation address Public Relations, Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

"Styled"

for non-overloading high efficiency

All Layne Impellers—the business end of a pump—are "styled" for the very maximum in high efficiency. Free from the overloading fault, these impellers are capable of producing tremendous quantities of water at unmatched low cost. All are hand finished inside and out to provide utmost accuracy.

If you are in need of a vertical turbine pump to produce water from a well, lake, reservoir or river—or as a pressure booster for a water main, write for a catalog on Layne Pumps. No obligation.

But whether you are checking impellers, pump bowls, shafting, bearings or other parts of a water supply unit, it is important to remember that Layne built wells and pumps are rated as the world's very finest. Everything about these units, are engineered for long years of top flight efficiency. Satisfactory service, extra heavy production and absolute freedom from structural weakness.

For further information about well installation services, sizes and types of pumps or a complete water supply contract, address

LAYNE & BOWLER, INC.

General Offices, Memphis 8, Tenn.

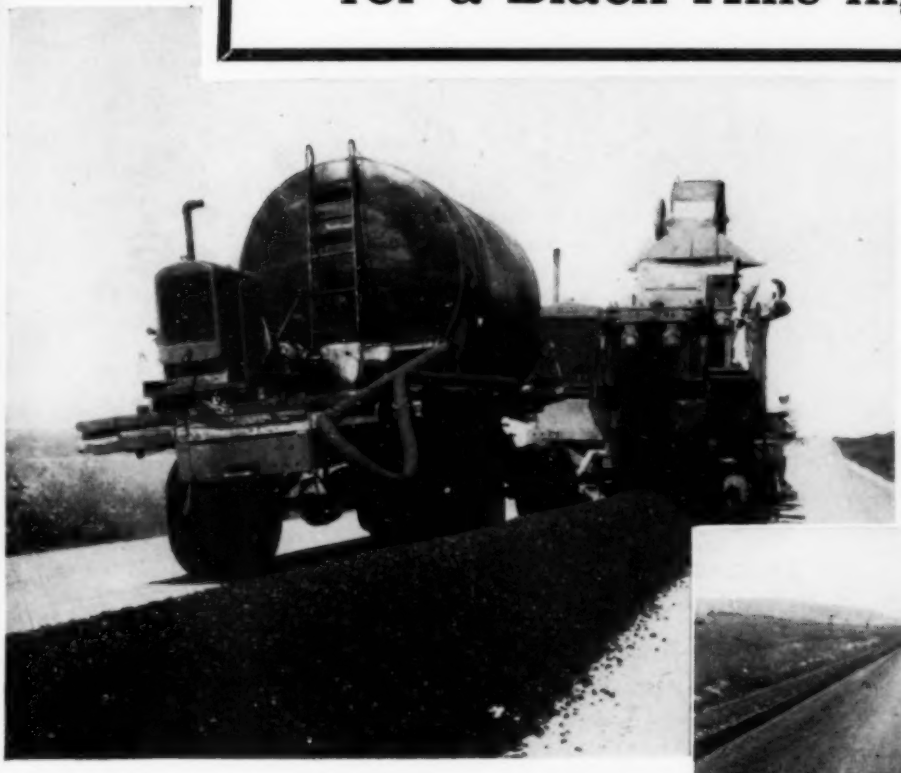
Layne

WATER WELLS

VERTICAL TURBINE PUMPS

WATER TREATMENT

A low-cost Texaco surface for a Black Hills highway



Texaco Slow-curing Asphaltic Oil and aggregate were mixed by travel plant in surfacing of this 10-mile section of South Dakota's Route 24 in the Black Hills area. Work done by the Northwestern Engineering Company, Rapid City, S.D.

The South Dakota Highway Department needed an intermediate-type of construction for 10 miles of State Route 24 in the Black Hills region. A travel plant and Texaco liquid asphaltic materials teamed up to give the State what it wanted—a serviceable, all-weather road at moderate cost.

A dense-graded aggregate was picked up by the travel plant from a windrow and mixed thoroughly with a Texaco Slow-curing Asphaltic Oil. The mix was spread evenly over the base and compacted, providing a tough, waterproof surface two inches thick. Texaco Rapid-curing Cutback Asphalts were used to prime the base and to seal the new surface.

This South Dakota project is another example of the variety of ways in which Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils are successfully employed in the construction of roads, streets and airports. There are two reasons why your Texaco Asphalt pavement will stand up under whatever traffic and climatic conditions it is called upon to serve: (1) The experience of almost half-a-century goes into the refining of Texaco Asphalt products; (2) Every Texaco Asphalt material is a product of scientifically selected crudes.

Faithfully yours 50 *for Fifty Years*

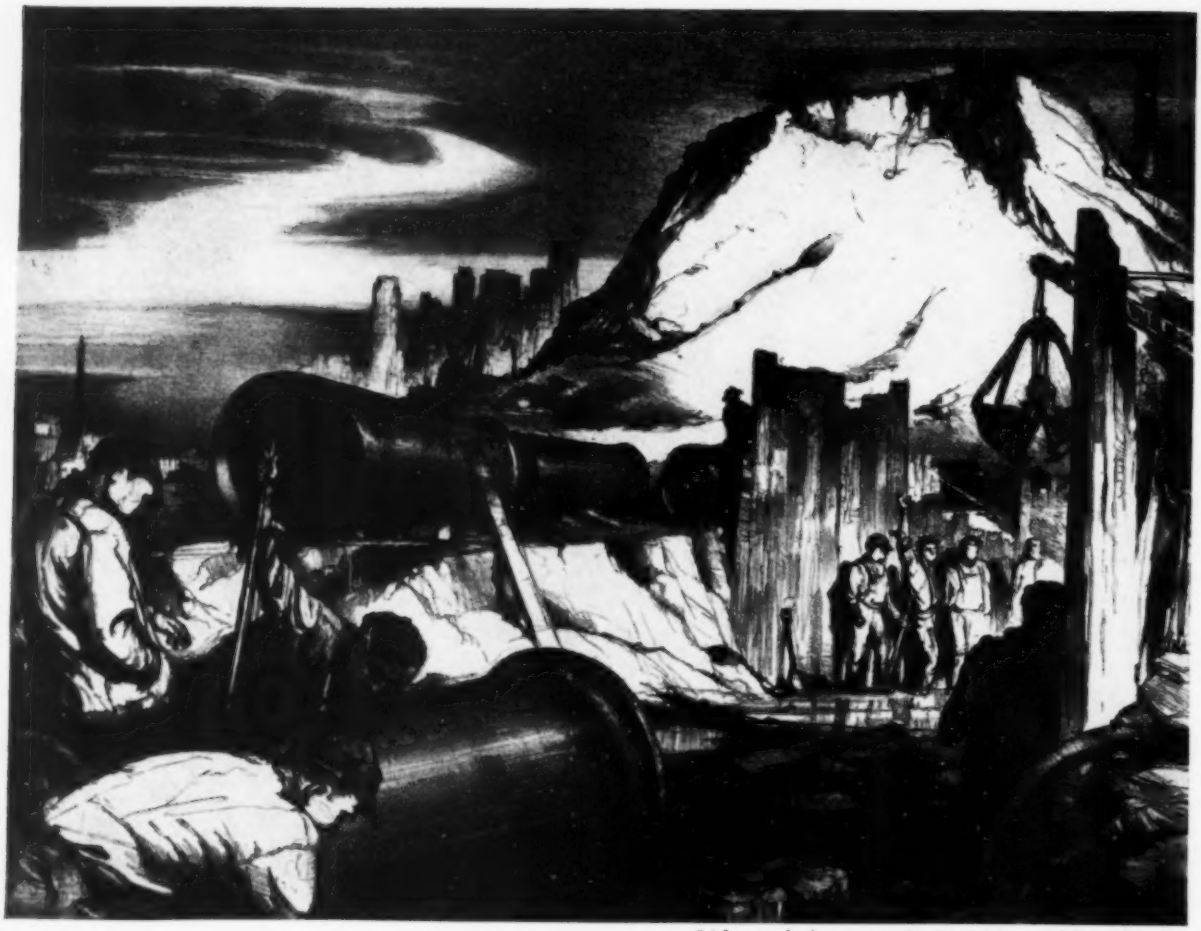
Two helpful booklets covering all types of Asphalt road and street construction can be had without cost or obligation by writing our nearest office.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

Boston 16 • Chicago 4 • Denver 1 • Houston 1 • Jacksonville 2 • Minneapolis 3 • Philadelphia 2 • Richmond 19

TEXACO

TEXACO ASPHALT



Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A.N.A.

LARGE DIAMETER cast iron pipe, as illustrated, are efficiently serving as water, gas or sewer mains in large cities throughout the country. If this were a water supply line or an intercepting sewer, either bell-and-spigot or mechanical joint pipe might be used; however, for a gas feeder main these days it would most likely be mechanical joint.

Our pipe 30-inch and over, flexible joint and integral flange pipe are all made by the pit cast process. Pipe in sizes 2-inch through 24-inch are cast centrifugally in metal molds with bell-and-spigot, mechanical joint or plain ends. No matter whether pit cast or centrifugally cast, the quality of our pipe is scientifically controlled throughout its manufacture.

United States Pipe and Foundry Co.,
General Offices, Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

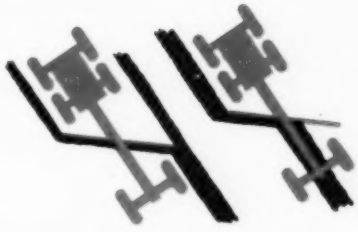
This A-W Grader Sure Handles Oil Mix FAST!

"I take off my hat to All-Wheel Drive and All-Wheel Steer."

Whenever you see an Austin-Western Power Grader with its rear end off-set like this, you can be sure that it is moving more material farther and doing the job faster than an ordinary motor grader could do it. We call it "CONTROLLED TRACTION." Here's how it works:

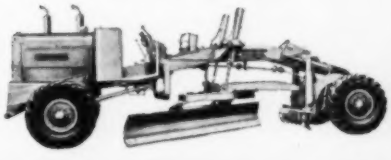
All wheels miss the windrow. The rear drivers push behind the toe of the blade; the front drivers pull ahead of the heel of the blade, and the grader moves straight ahead with a load along the entire blade that would cause an ordinary motor grader to become unmanageable.

PRECISION SIDESHIFT moves the blade in or out, as desired, while the grader is in motion. Ample throat room between top of blade and bottom of circle makes it possible to move a tremendous windrow without interference. The lay-down is handled with the precision that satisfies the most critical engineer.



On the ordinary motor grader, the operator has two alternatives; split the windrow and move less material, or straddle the windrow and not move it the full distance. Each of these procedures slows down the job.

CONTROLLED TRACTION puts the rear end of the machine where it will most effectively resist the side-thrust of the load on the blade . . . saves time and money on a wide variety of grading and ditching jobs. Only Austin-Western has CONTROLLED TRACTION . . . because only Austin-Western has All-Wheel Drive and All-Wheel Steer.



AUSTIN-WESTERN COMPANY · *Subsidiary of Baldwin-Lima-Hamilton Corporation* · AURORA, ILLINOIS, U.S.A.

Austin Western

BALDWIN BLH LIMA-HAMILTON

SINCE 1859—BUILDERS OF CONSTRUCTION EQUIPMENT

THE KANSAS CITY STAR. MAIN EDITION

KANSAS CITY, JUNE 7, 1952—SATURDAY—16 PAGES. PRICE 5 CENTS

A BIG DOCK BLAZE

DEFENSE AT TOP

A Great Newspaper Scores Another 'BEAT'

KANSAS CITY STAR SOLVES PROBLEM OF HANDLING NEWSPRINT —'INCOR' SPEEDS CONSTRUCTION OF UNDER-STREET TUNNEL

• Many of the nation's metropolitan newspapers haul truckload after truckload of newsprint over busy city streets. But not The Kansas City Star. This great paper moves the 70,000 tons it uses each year direct from railroad car to press, on what is said to be the only conveyor line of its kind in use today.

A month's paper supply is stored in a fine, new, fire-safe warehouse, concreted throughout with Lone Star Cement. And under busy Grand Ave., a new tunnel connects the warehouse with The Star's main building.

Building the tunnel without tying up heavy Grand Avenue traffic was a problem. The designers and builders solved it in the now-characteristic American way—the way builders the country over score a "beat" when time, traffic, weather, and form costs pose a problem—that is, by using 'Incor,'* America's FIRST high early strength portland cement. Result, earlier completion, less job overhead, minimum traffic interference.

*Reg. U.S. Pat. Off.

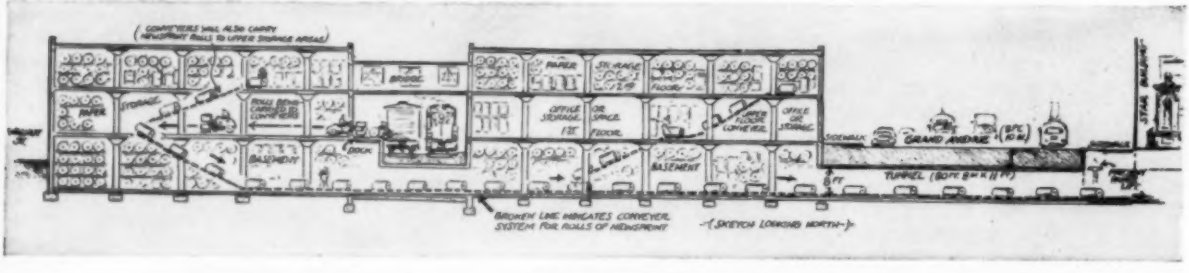
THE KANSAS CITY STAR
Paper Warehouse and Tunnel

Architects:
NEVILLE, SHARP & SIMON

Contractor:
COLLINS CONSTRUCTION COMPANY

Ready-mix 'Incor' Concrete:
STEWART SAND & MATERIAL COMPANY
—all of Kansas City, Mo.

Sketch below shows how The Star handles newsprint, from railroad car to storage in new warehouse, thence by conveyor under railroad tracks and tunnel under Grand Avenue to presses in main building.



LONE STAR CEMENTS COVER THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ABILENE, TEX. • ALBANY, N. Y. • BETHLEHEM, PA. • BIRMINGHAM
BOSTON • CHICAGO • DALLAS • HOUSTON • INDIANAPOLIS
KANSAS CITY, MO. • NEW ORLEANS • NEW YORK • NORFOLK
PHILADELPHIA • RICHMOND • ST. LOUIS • WASHINGTON, D. C.

LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 17 MODERN MILLS, 125,600,000 SACKS ANNUAL CAPACITY

VOLUME 22

NUMBER 8

CIVIL ENGINEERING

AUGUST 1952

THE MAGAZINE OF ENGINEERED CONSTRUCTION

WALTER E. JESSUP . . . . . *Editor*
C. E. BEAM . . . . . *Publication Manager*
ROBERT K. LOCKWOOD . . *Associate Editor*

Assistant Editors
Ruth G. Campbell . . . . . *Articles*
Mary E. Jessup . . . . . *News*
Doris A. Braillard . . . . . *Production*
JAMES T. NORTON . . *Advertising Manager*

EDITORIAL & ADVERTISING DEPARTMENTS
33 W. 39th St. New York 18, N.Y.

ADVERTISING REPRESENTATIVES

- ROBERT S. CYPHER
  33 W. 39th St., New York 18, N.Y.
- DWIGHT H. EARLY
  100 North La Salle St., Chicago 2, Ill.
- McDONALD-THOMPSON COMPANY
  625 Market St., San Francisco 5, Calif.
  3727 West Sixth St., Los Angeles 5, Calif.
  Terminal Sales Bldg.,
  1st & Virginia Sts., Seattle 1, Wash.
  1118 Odeans Drive, Dallas 11, Tex.
  115 Southwest 4th Ave., Portland 4, Ore.
  317 Railway Exchange Bldg., Denver, Colo.
- L. H. DOLARO
  Transatlantic Publicity Ltd.
  20–21 Broad St. Ave., Blomfield St.,
  London, E.C. 2, England

SOCIETY OFFICERS
CARLTON S. PROCTOR . . . . . *President*
WILLIAM N. CAREY . . . *Executive Secretary*
E. LAWRENCE CHANDLER *Assistant Secretary*
JOSEPH H. EHLERS . . . *Field Representative*
1026 17th St., N.W., Washington 6, D.C.

The Society is not responsible for any statements made or opinions expressed in its publications.

SUBSCRIPTION RATES—Price 50 cents a copy. $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

PRINTING—Reprints from this publication may be made on condition that full credit be given to the author, copyright credit to CIVIL ENGINEERING, and that date of original publication be stated.

COPYRIGHT, 1952, BY THE AMERICAN SOCIETY OF CIVIL ENGINEERS
Printed in U.S.A.

Member Audit Bureau of Circulations

39,700 copies of this issue printed

IN THIS ISSUE

Puerto Rico develops safe water supplies for its citizens . . . *Sergio Cuevas* 25
Can errors in bids be corrected? . . . *Walter C. Sadler* 29
Steel arch analyzed and designed by semigraphical methods . . . *Milo S. Ketchum* 30
Applied mechanics specialist is consultant to engineers . . . *J. N. Goodier* 35
Cantilever frames support thin-shell roof . . . *Boyd G. Anderson* 36
Making "the breaks" . . . *Arthur R. Pell* 40
Deep sand-island caissons support Cincinnati steam plant . . . *Leonard V. Smoot* 42
Is prestressing the answer? . . . *Jacob Feld* 47
Add-area method extended to include composite sections . . . *Dewey M. McCain* 52
Shortcut calculating-machine method computes P.I. of two lines . . . *Wm. F. Warfield* 53

Centennial Convocation, Chicago, Ill., Sept. 3–13, 1952:
Program for Symposiums of General Interest . . . 56
Program for ASCE Convention . . . 64

SOCIETY NEWS

Details of Pageant, Technical Exhibits and Other Centennial Features . . 76
Induction of Five New Honorary Members Centennial Convocation Feature . 77
ASCE Prizes to Be Awarded at Centennial Convocation . . . 79
Information Wanted from Consulting Engineers . . . 85
Tellers Canvas Ballot for 1953 ASCE Officers . . . 85
From the Nation's Capital . . . 86
News of Local Sections . . . 88

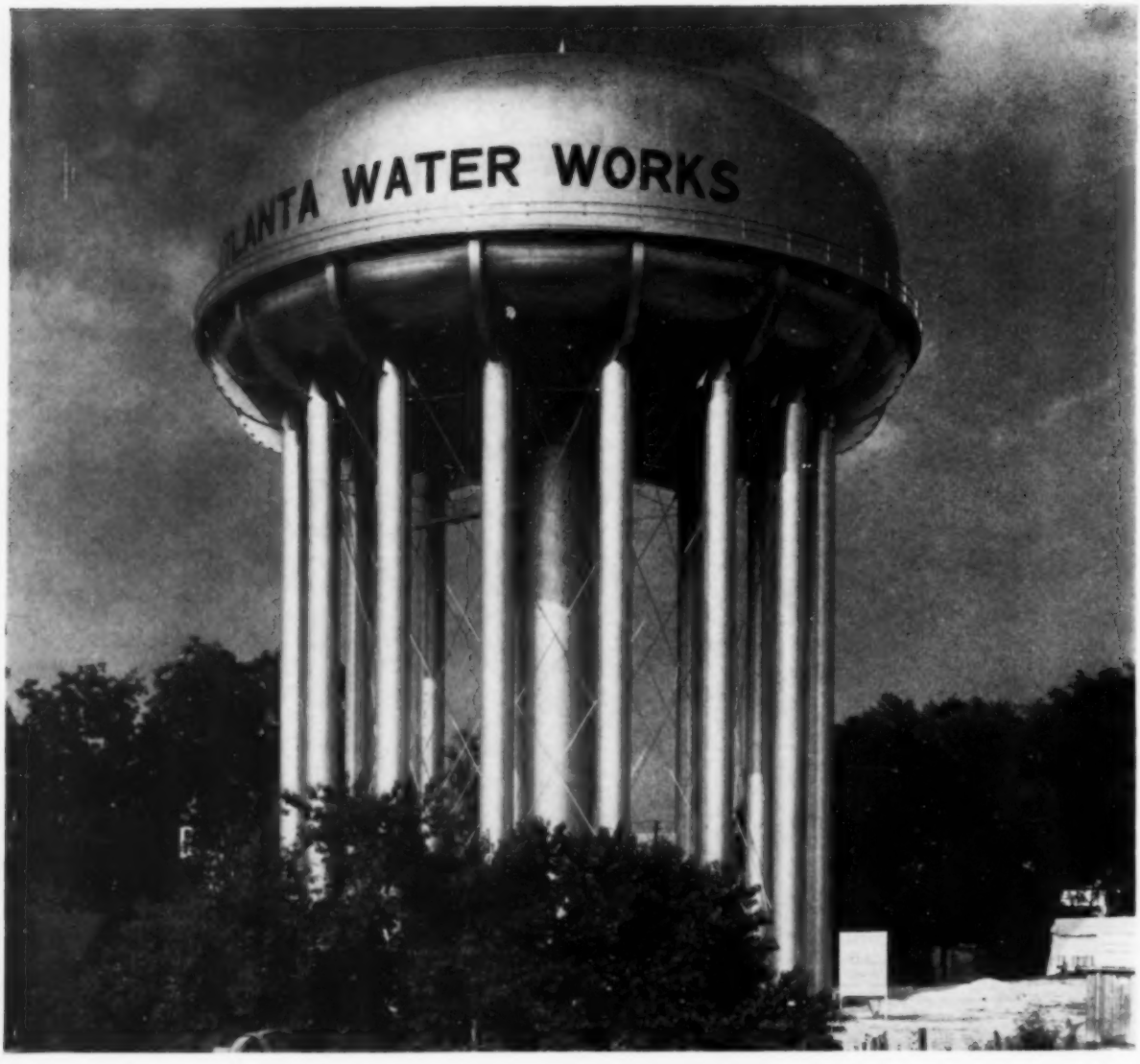
NEWS BRIEFS

Architect-Engineer Cooperation Urged at 84th Convention of AIA . . . 90
ASTM Celebrates Its Fiftieth Anniversary . . . 92
Interpretation Defines "Professional Engineer" . . . 93
Record Construction Outlays in First Half of 1952 Reported . . . 94
Need for More Engineers Stressed at ASEE Meeting . . . 94

DEPARTMENTS

How Would You Do It? . . . 41
Engineers' Notebook . . . 52
The Readers Write . . . 55
N. G. Neare's Column . . . 95
Deceased . . . 96
News of Engineers . . . 100
Men and Jobs Available . . . 102
Positions Announced . . . 104
Non-ASCE Meetings . . . 104
Recent Books . . . 106
Applications for Admission . . . 111
Equipment, Materials, Methods . . . 112
Literature Available . . . 117
Index to Advertisers . . . 124

Proceedings Papers Available as Separates . . . 119



Supplying 55,000,000 Gallons of Water to Atlanta

The city of Atlanta, Georgia, supplies 550,000 people and 1,200 industries with an average of 55,000,000 gallons of water per day. This is done through 85,000 metered services and a water works system valued at $40,000,000.

Atlanta spends approximately $1,000,000 per year on extensions and improvements on its water works system. A recent addition to the system is the 2,000,000-gallon Horton radial-cone bottom elevated tank shown above. This structure is 102 ft. in diam., 90 ft. to bottom and has a 35 ft. range between the upper and lower water levels. It is located in the southwest section of the city known as the 4-mile zone and went into operation on August 6, 1951.

The 2,000,000 gallon Horton elevated tank was installed at Atlanta to cut down daily peaks on pumping and filter equipment, reduce pumping pressures, and improve distribution pressures in the immediate area. Prior to its installation, distribution pressure in city mains near the tank varied from 25 to 50 lbs. per sq. in. The pressure range is now between 40 and 50 lbs. per sq. in.

* * *

Horton radial-cone bottom elevated tanks are avai able in standard capacities from 500,000 gallons to 3,000,000 gallons. Write aur nearest office for further information and estimates

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3.....2167 Healy Bldg.
Birmingham 1.....1596 N. Fiftieth St.
Boston 10.....1009—201 Devonshire St.
Chicago 4.....2199 McCormick Bldg.
Cleveland 15.....2263 Guildhall Bldg.
Detroit 26.....1541 Lafayette Bldg.
Havana.....402 Abreu Bldg.
Houston 2.....2128 C. & I. Life Bldg.
Los Angeles 17 1556 General Petroleum Bldg.
New York 6.....3395—165 Broadway Bldg.
Philadelphia 3..1652—1700 Walnut St. Bldg.
San Francisco 4.....1584—200 Bush St.
Seattle 1.....1309 Henry Bldg.
Tulsa 3.....1647 Hunt Bldg.
Washington 6, D.C.....1156 Cafritz Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

CIVIL ENGINEERING

AUGUST 1952

THE MAGAZINE OF ENGINEERED CONSTRUCTION

Puerto Rico develops safe water supplies for its citizens

SERGIO CUEVAS, M. ASCE

Executive Director

Puerto Rico Aqueduct and Sewer Authority

San Juan, Puerto Rico

Nearly half of Puerto Rico's population will be served with safe domestic water by Rio Grande de Loiza Development, the island's most important single water-supply project. Loiza Dam, 700 ft long and 96 ft high, will store 20,000 acre-ft and divert it by pipeline to Loiza Filtration Plant.

Until 1940, Puerto Ricans thought that their living problems had no remedy and that what awaited them was a future of greater privations, full of grief, disease, misery, and despair. In an effort to free the island from the uncertainties and latent dangers of dependence on a single crop—sugar—the government is sponsoring a vast program of industrialization. At the same time, it is carrying forward a dynamic program of general improvements to better the health and economic and social conditions of the people of the island. This double-barreled program, initiated ten years ago, has already shown results. The number of schools and the pupil enrollment have increased to record figures. New roads have been constructed at a rate of about 75 miles a year. A comprehensive public housing program has been developed, which is astonishing

Puerto Rico . . .

New Loiza Filtration Plant purifies 30 mgd of water for Puerto Rico's metropolitan zone. Below is seen portion of filter gallery. Treatment consists of aeration, coagulation, flocculation, settlement, rapid sand filtering, and chlorination. Guaynabo Filtration Plant (facing page) purifies 26 mgd for metropolitan area. See map, Fig. 1. In addition to 11 other filtration plants, eight small filter plants, 0.35- to 1.0-mgd capacity, are under construction to provide fully treated water to small towns on the island. Deep wells supply water to some areas.

considering the smallness of the island. The system of hydroelectric and steam electric plants has been expanded to provide power for growing industries and thousands of new homes. Nearly 200 new industries have been set up. Public health has been greatly improved, making the island one of the healthiest places in the world. The island income has increased from 200 million in 1940 to 900 million in 1952. Last but not least, there has been great improvement and expansion of the water supply and sewerage facilities.

The Island of Puerto Rico, with its total area of 3,421 sq miles and its estimated population of 2,250,000, is the smallest of the Greater Antilles. Its location in the tropical Caribbean is such that it is only six hours by air from New York, four hours from Miami and within easy reach by plane of the continental United States and South America. It is, therefore, the logical crossroads of the Americas.

The Puerto Ricans, as citizens of the United States, enjoy all the rights and privileges of citizenship, except the right to vote for the President or members of the Congress. Our local government, wholly in the hands of Puerto Ricans, is an example of complete self-government. The governor is elected by the people and the laws are enacted by a legislature, likewise elected by the people. "The Commonwealth of Puerto Rico" is the government of the Puerto Rican people in its fullest democratic conception.

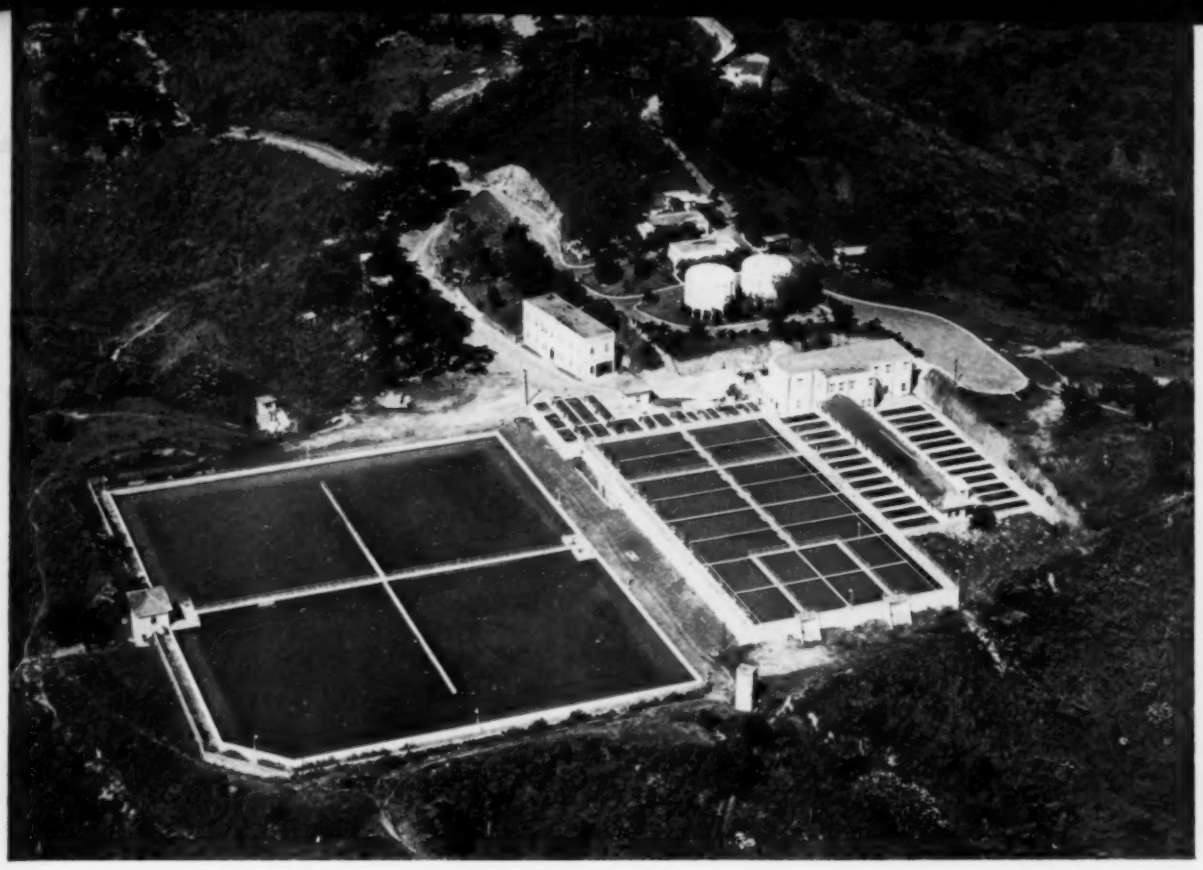
The general topography of the island is mountainous. The average temperature is 80 deg F in summer and 70 deg during the winter months—a very delightful tropical climate all the year round. In general, the rainfall is ample but there is considerable variation throughout the island.

The Puerto Rico Aqueduct and Sewer Authority was created in 1945, as a public corporation, along lines similar to the Tennessee Valley Authority. As stated in the law, the Authority was "created for the purpose of providing and helping to provide to the inhabitants of Puerto Rico, at the lowest possible cost, an adequate water supply and sanitary sewage disposal." The act also provided for the transfer to the Authority of all useful property and water franchises operated or controlled by the people of Puerto Rico or its municipalities, for the disposal of sewage or for supplying water for domestic, industrial, or commercial use.

The creation of the Authority united under one agency all the water supply and sewer systems of all the towns on the island, thus providing central management. In certain zones, physical integration and coordination have also been accomplished insuring economy, efficiency, and the best use of the natural resources available. These results were not obtained without some difficulties and obstacles at the beginning. However, all agencies and consumers now cooperate with the Authority in a helpful manner.

The island of Puerto Rico contains 76 municipalities which constitute political subdivisions. However, in a certain sense, the island itself is one large city—a city of 2,250,000 inhabitants living on 3,421 sq miles of land of which only 40 percent is arable. The population per square mile of arable land is 1,600.

This striking density of population creates equally striking problems. The pollution of surface waters is general. Since the watershed areas are all well populated, it is impracticable to obtain uncontaminated water through upland storage. The banks of the rivers and creeks, as well as those of lakes and ponds, are almost completely devoid of trees. During the rainy season, streams are flooded



with highly turbid waters, containing at times as much as 20,000 ppm of turbidity. In the dry season, the waters in natural courses dwindle to such an extent that in some places there is hardly enough to supply the population. The water works that were in existence at the time the law was passed were insufficient, obsolete, or in very bad condition. The municipalities were weighed down with economic and technical problems and were unable to improve the situation.

There are now about 950,000 persons living in the towns and cities of Puerto Rico. An additional 1,300,000 live in small villages and rural areas. At present, all the urban population and about 350,000 inhabitants of the rural zones have either a supply of running water or access to public fountains. These public fountains are conveniently located and supply the people gratuitously with water for which, however, the government pays the Authority.

As things stand today, twenty towns as well as the neighboring Island of Vieques (a total population of some 85,000), are supplied by deep wells which furnish pure, clean, and healthful water. Thirty-two towns, with a combined population of 710,000 inhabitants, have water which receives complete treatment in modern and efficient filtration plants. Ten towns, with a total of 60,000 inhabitants, have water which has been submitted to the whole process of purification with the exception of filtering. The other fifteen towns, with 95,000 inhabitants, will have modern filtration plants within the next three or four years. In the meantime, care is being taken to chlorinate the water supply adequately. In addition, more than 150 small systems have been built in rural areas.

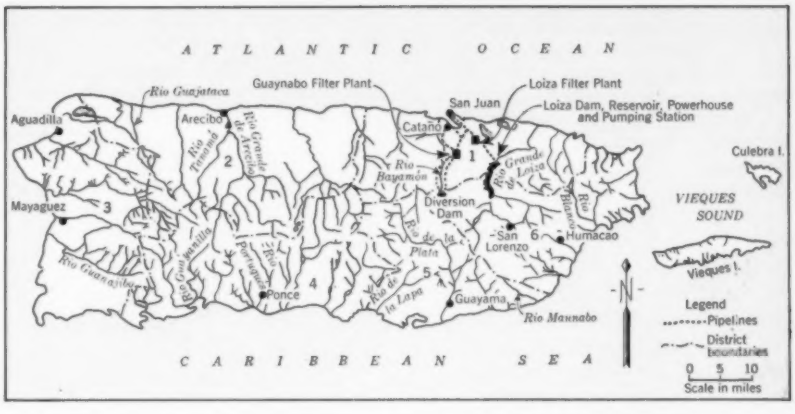


FIG. 1. Rio Grande de Loiza Project provides 30 mgd of potable water to Metropolitan District, which includes city of San Juan and surrounding towns having present population of 545,000. Main 48-in. concrete pipline from Loiza Dam involves pump lift over 150-ft summit.

The most important single project, now nearing completion, is the Rio Grande de Loiza Development which will serve the Metropolitan Zone, with a combined population of 800,000 in 1960, and 1,100,000 by 1970. The project includes:

1. A concrete dam with a crest 50 ft high, topped by tainter gates 30

Because of dense population, 1,600 per sq mile of arable land, pollution of surface waters is general. Lares sewage treatment plant, clarifying equipment for which is here shown, is one of typical installations for control.

ft high and 39 ft wide. The tainter gates stretch across the full 312-ft length of the spillway. The total length of the dam is 700 ft. The gates will be operated by individual hoists, and a special gated sluiceway will carry debris over the dam.

2. Three electric generating units of 1,250-kva capacity each. The permanent pumps, located in the power plant, will be operated by electric motors. The power output will be 14,000,000 kwhr annually, of which about two-thirds will be surplus to be disposed of by sale to the Water Resources Authority, which furnishes power throughout the island.

3. A 48-in. reinforced concrete supply pipe 4.0 miles long. This pipeline will carry the raw water from the dam over a summit 150 ft above the reservoir, to the filtration plant.

4. The 30-mgd Rio Grande de Loiza filtration plant which can be expanded to 60-mgd capacity. The chief features of this plant are: spray-type aeration; two basins for rapid mixing each with a capacity of 22,000 gpm and a detention period of 10 sec at 60 mgd; four units for flocculation with a total detention period of one hour at 30 mgd; four compartments for settling with a total detention period of 4.4 hours at 30 mgd; 12 rapid sand filters each of 2.62-mgd capacity; two manually controlled chlorinators for prechlorination and two for post chlorination with a capacity of 2,000 lb per day each; six gravimetric-type dry-feed machines and two volumetric-type dry-feed machines for chemical feed; a 500,000-gal basin with centrifugal pumps for wash water; and a 10,000,000-gal distribution storage reservoir.

The Rio Grande de Loiza development, when fully completed, will solve the water supply problem of the Metropolitan Zone. The capacity of all components can be easily increased if necessary.

Once the influence of local politics was eliminated from the operation of the water works, it became possible to enforce payment for service by all those who were supplied with water, including insular and municipal government buildings and services. The mass installation of meters was then undertaken for the purpose of avoiding waste and ensuring adequate revenues. A physical count of the water users was made; a scientific routing system was put into practice; and a modern system of billing with International Business Machines was established. A plan for the installation of meters was drawn up so that within a period of 30 months the water received by 95 percent of the subscribers was duly measured.

To date the Authority has been able to accomplish the following aims; reduce waste, improve conditions of service, provide a better quality of water, stabilize revenues, and consolidate its economic base. These achievements in turn have permitted the financing of additional works, including improvements worth $20,000,000, among which are filtration plants for more than 40 mgd and over 600 miles of new pipelines. Moreover water has been placed at the disposal of double the number of people who enjoyed it in 1945, when the Agency was organized.

Experience over the past 7 years has made it evident that, in order to guarantee efficient water and sewer service as a governmental function, the administrative and technical management of such facilities should be separated from regular political government activities. However, the cooperation of government authorities as well as of private citizens and civic organizations is essential. Installation, of meters curtails waste, stabilizes revenues, reduces cost of operation, and extends the useful life of plants and equipment. In low-income countries, free water service as a governmental obligation should be provided to those not able to pay for it. The water requirements for fire fighting commonly adopted in the continental United States are not applicable in Puerto Rico. This is also true of estimates for per capita consumption to be used in the design of water works and sewer systems.

Our experience shows that in Puerto Rico 40 percent of the urban inhabitants use only 15 gal per day per capita and the remaining 60 percent use varying quantities from 50 gal per day in the small towns to 100 gal per day in the large cities. The estimated consumption rate can be divided into four groups as follows:

Population Served	Per Capita Use
Up to 20,000	36 gal per day
Up to 50,000	42 gal per day
Up to 100,000	54 gal per day
Over 100,000	66 gal per day

These estimates include domestic or residential use, which in Puerto Rico represents 46 percent of the total; government use, which includes public offices, jails, schools, parks, and military bases, and which amounts to 18 percent; commercial use, which amounts to 29 percent; and industrial use, which amounts to only 7 percent. All efforts should be made to eliminate waste of water, and advantage should be taken of underground water supplies.

To render efficient service is the best means of maintaining good public relations. The Authority has won the confidence of the people and has ensured good financial credit for itself. Its purpose is to provide the inhabitants of the island—all of them—with an abundant supply of good, cheap water. Today its resources are over $60,000,000. Its water mains carry pure water great distances to the homes of those who live in poverty as well as to the homes of those who are more fortunate. Its future is no longer a cause for anxiety but rather a promise of accomplishment.

Can errors in bids be corrected?

LAW

WALTER C. SADLER, M. ASCE, Civil Engineer and Attorney-at-Law, Ann Arbor, Mich.

An error in bidding may become a very serious matter. For instance, a proposal could total $340,000 in place of $390,000, possibly because of an inadvertent omission of $50,000 in overhead costs. On discovery of his mistake, the contractor would desire to withdraw his bid and his certified check, or at least to correct the error, while the owner would demand compliance with the bid or at least forfeiture of the bidder's certified check. The available procedures include:

Enforcement, in strict compliance with the erroneous bid
Revision of the bid to correct the error
Annulment of the bid

Enforcement. This presents definite matters of policy. The success of a project depends on the attitude of the parties to the contract, and to force an agreement on an unhappy contractor is certain to jeopardize success. On the other hand, an owner's ruthless insistence on holding the certified check is hardly consistent with the concept of a voluntary entry into a transaction. The demand for a "pound of flesh" does not meet with general approval, and the courts are inclined to show sympathy for a contractor in honest difficulty.

This reluctance to enforce an erroneous bid relates only to "material" mistakes, since minor errors must be accepted. This distinction is realistic, too, for the courts could never handle the multitudinous errors which are the daily products of human frailty. There should certainly be some restraint on negligence and indifference, or every minor slip of a slide rule might constitute a pretext for avoiding fair contractual responsibilities. The harsh enforcement of an erroneous proposal constitutes an unrealistic, and an unfair, solution to a difficult problem.

Revision. The error might be corrected by permitting a substitution of the new sum for the old, by adding an item inadvertently omitted, or by reducing an amount which was made too high through error. The bidder's best argument would be that the bid as submitted was not his "intent" since it did not represent the sum he desired. Such a correction, however, would be disadvantageous to the other parties to the bidding. To raise the bid would make the owner unhappy, whereas to lower it would irritate every other contractor.

The error in a bid is one sided, or unilateral, and there is a rule that unilateral mistakes of fact cannot be corrected. If it is desired to maintain the present high level of competitive bidding, there must be no revision, change, alteration, or tinkering with proposals as submitted.

Revision does not offer a satisfactory remedy for an erroneous proposal. Potentially distasteful to all parties to the bidding, revision hardly represents the true intent of any one and is certainly a very dangerous threat to the present high integrity in competitive bidding on public works.

Annulment. The cancellation of an erroneous proposal requires careful consideration of the following factors:

Importance and nature of the mistake
Cause of the mistake
Action taken by the contractor
Knowledge and care of the owner
Attitude of the owner
Potential benefit to the contractor by the cancellation
Potential injury to the owner by the cancellation

As indicated previously, a mistake must concern an important part of a contract, such as a substantial error in the purchase price. It cannot be some superficial matter. The bidder alone is responsible for failing to examine or to check trade quotations, or for making a mistake in judgment as to the probable wage scale. On the other hand, it is well known that cost estimating is an arduous task, requiring long hours. In one instance of a serious error in a proposal, the court took notice of an estimator's long work hours over a four-day period with only one hour of sleep on the final night. The resulting error was understandable.

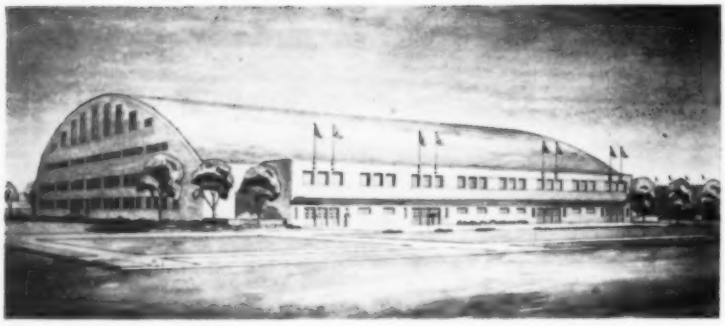
The opening of the bids immediately discloses any substantial discrepancies, and, if a contractor anticipates equitable relief from his mistake, he should act swiftly. He should promptly reexamine his proposal, locate his mistake, and present his case to the owner. There is a normal lull of a few days between the opening of the bids and the official action of the owner. The contractor must assume a clean-cut and definite position on cancellation if that is what he proposes. Time is of the essence, for the owner should be warned of the error before he innocently accepts the incorrect bid.

When an owner receives a very low bid, it seems "too good to be true." In fact, this startlingly good news should be the very thing that places him on his guard. The preparation of the proposal blanks, contract bonds, and certified check presupposes a legally enforceable relationship, irrespective of errors. An ordinary businessman knows that the certified check insures the signing of the contract. If the contractor detects his error, refuses to sign the contract, and demands the return of his check, he may have to build up special grounds for relief in a court of equity. Should the owner cunningly accept the low, erroneous bid, knowing it to be erroneous, equity may term enforcement as unconscionable. Although he apparently has the law on his side, the owner indicates poor faith in trying to snap up the bargain.

The potential effect of the cancellation of the proposal will be a benefit to the contractor, and a detriment to the owner. If the error is so unconscionable as to be obnoxious to a court of equity, the contractor has a strong case. On the other hand, the owner may anticipate considerable difficulty in establishing his injury. The owner's loss of his bargain is not applicable since he has no real claim to something that is inequitable. The next lowest bidder is standing by, so the only loss to the owner is the potential delay caused by the incident and other minor matters.

Conclusion. Where the circumstances warrant, an erroneous proposal will be canceled. The court will neither order return of the certified check to the contractor nor permit the owner to retain the sum. The certified check will be held by the court, allowing the owner to establish his actual injuries if he has any. After the owner's loss has been deducted, the rest of the check will be returned to the contractor.

FIG. 1. University of Wyoming Field House is two-hinged arch resting on A-frames. Arches are spaced 27 ft 3 in. on centers.



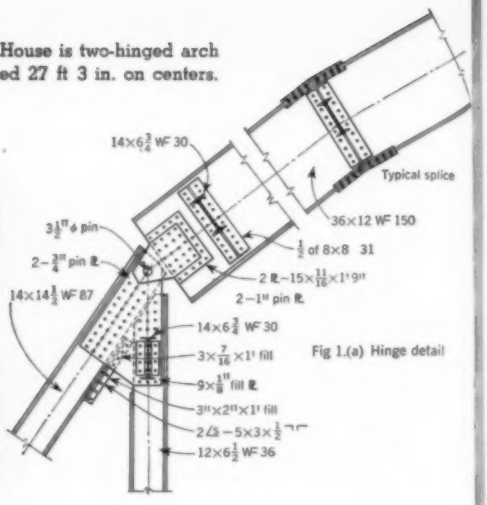


Fig 1.(a) Hinge detail

Steel arch analyzed and designed by

MILO S. KETCHUM, A.M. ASCE

Consulting Engineer, Denver, Colo.

Structurally the University of Wyoming Field House is a two-hinged steel arch resting on A-frames. It has a span, from center to center of pins, of 221 ft, a ceiling height of 60 ft, and a rise above the pins of about 39 ft. Its capacity for basketball is about 11,000 persons.

Steel I-beam arches were selected because they were believed to be the least costly for the conditions encountered. It was not necessary to have a fireproof building. The basic requirement was a main floor area 220 × 168 ft with folding bleachers capable of being removed for football practice. The height of the end wall for clearance purposes was set at about 20 ft. These considerations dictated the section shown in Fig. 1. The A-frames reduce the span of the arches from about 287 ft to 221 ft and decrease the overall width of the building by 16 ft. Studies were made to decide whether a pin or a rigid connection should be used at the top of the A-frame. After consideration of all the factors, the use of a pin at the springing line of the arch was adopted, and the erection hinge at the crown was omitted.

The arch is circular and its segments are uniform in length. There was no advantage in the parabolic shape because the thrust is only a small part of the total stress, and the bending moment of the circular shape is not much larger than that of the parabolic shape. The greatest advantage of the circular shape is that it makes the milling angle on the ends of all the arch segments the same.

Design of the arch followed the Pacific Coast Building Officials Conference, Uniform Building Code (1949 edition), except as noted below under the description of the allowable design loads. The principal loads are dead load, snow load, ice load, and wind load, or combinations of these. The dead load is not an important consideration because it is not unbalanced and creates very little bending moment in the arch section. The probability of simultaneous maximum snow load and maximum wind load, or ice load, is not very great. Also it is probable that the maximum snow load will occur only over the entire span. If there is unbalanced load, it will probably be from ice.

Loadings Used

On the basis of these considerations, the following loads were chosen:

1. Dead load of 22 psf of roof surface
2. Snow load of 30 psf of roof surface over the entire span
3. Ice load of 15 psf of roof surface for partial loading
4. Wind load of a basic 20 psf (77.8 mph) in accordance with the report of Subcommittee No. 31, of the Structural Division of the ASCE (published in ASCE TRANSACTIONS, vol. 105, 1940, page 1717). Unit stresses were increased 33.3 percent for combinations involving wind load.

As this structure was the first of its type designed in the office of the writer, elaborate calculations were made using the exact lengths of arch segments and ordinates, drawing influence lines, and taking off areas. After the arch had been designed by these methods, it was concluded that it could have been analyzed and designed by semigraphical methods without the loss of real accuracy. The position of loads that gives maximum moment is not critical, so that a

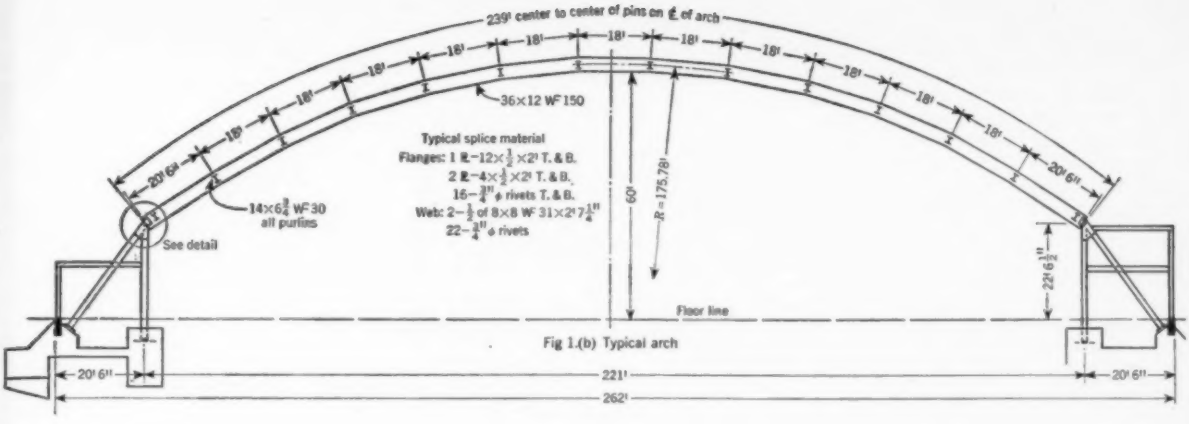


Fig 1.(b) Typical arch

by semigraphical methods

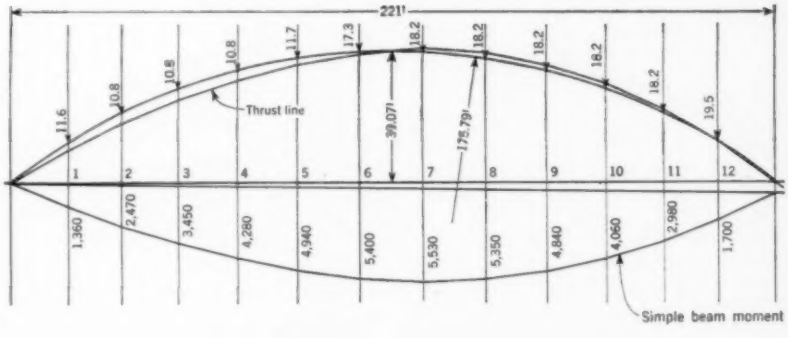
University of Wyoming Field House accommodates 11,000 spectators

design loading with an ice load over 0.6 of the span is entirely satisfactory. The methods described and shown in the figures are not the original ones, but are those that would be used if another arch were to be designed in this office.

The simpler the method, the more the time available for study of the various arrangements of purlins, spacing of arches, selection of sections, design of bracing, design of foundations, and other structural features.

Calculations for dead and partial live loads, shown in Fig. 2, follow the usual method of analysis for two-hinged arches. All loads are assumed to be concentrated at the purlin points. The dead-load concentration is $22 \times 18 \times 27.25 = 10.8$ kips. The ice load is $15 \times 18 \times 27.25 = 7.4$ kips. For convenience all lengths are in feet, and the value of I for the section is assumed to be unity. In this analysis the A-frames and the foundations are considered as rigid. The steel members in the frames are in direct compression and are 170 times as stiff as the arch section.

Steps in the analysis are as follows: (1) The arch center line is drawn and



Elastic weights, arch moments							
Point	y	L	y^2L (÷1000)	M	MyL ÷1000	yH	Moment in arch
1	11.9	19.2	2.72	1,360	311	− 1,640	− 280
2	20.7	18.0	7.71	2,470	921	− 2,850	− 380
3	27.8	·····	13.90	3,450	1,725	− 3,830	− 380
4	33.4	·····	20.10	4,280	2,570	− 4,610	− 330
5	37.0	·····	24.60	4,940	3,290	− 5,110	− 70
6	38.7	·····	26.90	5,400	3,760	− 5,330	+ 70
7	38.7	·····	26.90	5,530	3,860	− 5,330	+ 200
8	37.0	·····	24.60	5,350	3,560	− 5,110	+ 240
9	33.4	·····	20.10	4,840	2,910	− 4,610	+ 230
10	27.8	·····	13.90	4,060	2,030	− 3,840	+ 220
11	20.7	18.0	7.71	2,980	1,110	− 2,850	130
12	11.9	19.2	2.72	1,700	389	− 1,640	60
		Totals	191.86		26,426		

$H = \frac{26,426}{191.86} = 138k$

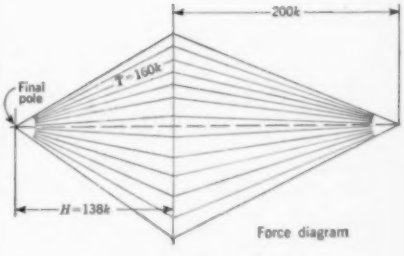


FIG. 2. Calculations for dead and partial live loads follow usual method of analysis for two-hinged arches.

the loads are calculated. (2) Loads are laid out on the force diagram and a random pole is chosen to the right in order to determine the bending moments in a simple beam, that is, with one end of the arch on rollers. (3) Elastic weights and horizontal deflections for a unit horizontal thrust, H, at the springing line and the simple beam moments are calculated in the table of Fig. 2, from which the horizontal thrust H is found to be 138.0 kips. (4) This value is set in the force diagram to the left of the load line, the vertical position having been determined from the previous calculation for simple beam moments. (5) With this pole, a thrust line for the loads on the arch is drawn.

Calculate the moment by subtracting the bending moment of the reaction, H, from the simple beam moments. If the loads had been other than vertical, it would have been more convenient to scale the perpendicular distance of the thrust line from the arch and take the thrust from the force diagram. From these calculations the maximum bending moment is 380 ft-kips and the maximum thrust at this point is 160 kips. A full snow load of 30 psf produces comparatively low moments, the maximum being 110 ft-kips with a horizontal thrust of 130 kips.

Buckling Moment Determined

There is an additional moment in arch structures caused by the tendency of the arch to deflect away from the thrust line. In two-hinged arches of this type it is simple to determine. The first step is to calculate (Fig. 3) the vertical deflection of the center line of the arch for the loading stated above. Again a semigraphical method is used. A moment diagram is drawn at the top of the figure, and the center line of the arch is shown as a horizontal line. These values are recorded in the table and the elastic weights are calculated, the direction of these loads being given below the moments. A force diagram is drawn for these weights and a bending moment diagram (deflections) is then drawn. The scaled distance on this diagram for the maximum deflection is 0.68 in. Correcting this for the proper units, for the values of I for a 36 WF 150 section, and for E, the maximum vertical deflection becomes 2.50 in.

If the thrust line had not been approximately parallel to the arch, it would have been necessary to determine the deflection perpendicular to the thrust line. This would have made the calculation much more complicated. However, it is sufficiently accurate to measure the increase in moment by the vertical deflection, Δ, times the horizontal thrust, H, or

$$M = 2.50 \times 138/12 = 29 \text{ ft-kips}$$

This additional moment will in turn produce an additional deflection. Fortunately it is not necessary to go through another calculation of deflections. Note that in Fig. 3 the shape of the deflection diagram is similar to the moment diagram. Therefore the additional deflection caused by the 33 ft-kip moment is, by proportion:

$$\Delta = 2.50 \times 29/380 = 0.19 \text{ in.}$$

The total deflection at this point is $2.50 + 0.19 = 2.69$ in. The final deflection, Δ^F, is obtained from the formula,

$$\Delta^F = \frac{\Delta}{1 - \frac{\Delta H}{M}}$$

This formula was presented by the writer in the ASCE TRANSACTIONS, vol. 108, page 1193. The final deflection is

$$\Delta^F = \frac{2.50}{1 - \frac{2.50 \times 138}{380 \times 12}} = 2.71$$

If the arch section had been quite small, the final deflection might have been very large, which would have indicated that the arch was in a critical buckling state. The additional bending moment is

$$M = 380 + 2.71 \times 138/12 = 411 \text{ ft-kips}$$

The combined unit stresses on a 36 WF 150 beam, with $A = 44.16$ sq in. and $S = 502.9$ in.^{3}, are

$$\text{Bending, } \frac{411 \times 12}{502.9} = 9.80 \text{ kips per sq in.}$$

$$\text{Compression, } \frac{160}{44.16} = 3.62 \text{ kips per sq in.}$$

The allowable stresses were based on the 36 WF 150 being laterally unsupported for an 18-ft length. Actually there is some lateral support from the wood purlins. The allowable stresses are:

$$\text{Bending, } \frac{12{,}000{,}000}{18 \times 12 \times 3.19} = 17.40 \text{ kips per sq in.}$$

$$\text{Compression, } \frac{1}{r} = \frac{18 \times 12}{2.38} = 91, \quad f = 12.98 \text{ kips per sq in.}$$

The unity formula of the Pacific Coast Code, Section 2703, becomes

$$\frac{9.80}{17.40} + \frac{3.62}{12.98} = 0.56 + 0.28 = 0.84$$

Therefore the arch has an ample margin over the 15-psf ice load used as a basic design load. These stresses are low, but the 36 WF 150 is the most economical section because of the jump in steel beam sizes.

The buckling stress is about 8 percent over the dead load plus ice load. If a smaller section than a 36 WF 150 had been used, the buckling stresses would have been larger. For example, if the arch ribs had been spaced at 18 ft 0 in. on centers, a 30 WF 108 would have been required and the additional percentage of buckling stress would have been about 12 percent. If a very thin arch rib is contemplated, then the effect of buckling stresses should be given a thorough study, particularly with respect to overloads, so the factor of safety will be consistent.

Wind Stresses Computed

Using wind loads recommended in the ASCE committee report previously referred to, the values for roofs starting from the ground level are as follows:

Windward quarter, 5 psf pressure
Central half, 11 psf suction
Leeward quater, 9 psf suction

Analysis for wind loads by a semigraphical method is shown in Fig. 4. Moments at the design points are obtained by scaling the distance of the thrust line from the arch and multiplying by the thrust at that point.

The maximum moment is 317 ft-kips, occurring in the opposite direction to the live-load stresses. The maximum combination of live load and wind load occurs with the wind blowing in the opposite direction and is -571 ft-kips. This combination reduces the thrust from 160 to 123 kips. The unit stresses are:

$$\text{Bending, } \frac{571 \times 12}{502.9} = 13.60 \text{ kips per sq ft}$$

$$\text{Compression, } \frac{123}{44.16} = 2.79 \text{ kips per sq ft}$$

The unity formula with stresses increased 33.3 percent becomes

$$\frac{13.6}{17.40 \times 1.333} + \frac{2.79}{12.98 \times 1.333} = 0.75$$

This value is less than for dead plus live load and is also less than unity.

The simplicity of construction of the arch results from the manner of splicing the segments. Fortunately it is not necessary to provide a full moment splice because milled joints are used. A sketch of a typical splice is shown in Fig. 1. A large part of the stress is direct stress, and the American Institute of Steel Construction Specification for Structural Steel for Buildings permits 50 percent of the computed stress to be carried by the milled ends. From the previous calculations the moment and thrust (not including wind) on the section are found to be respectively, M = 411 ft-kips and T = 160 kips. The eccentricity of the load about the center line is 411/160 = 2.57 ft = 30.8 in. The center of the splice is about 17.5 in. from the center line. Taking moments about the compression flange, the stress in the tension splice is

$$160 \times 13.3/35.0 = 61 \text{ kips}$$

The required number of $^7/_8$-in. round rivets at 18.04 is 59/18.04 = 4. This condition is not critical.

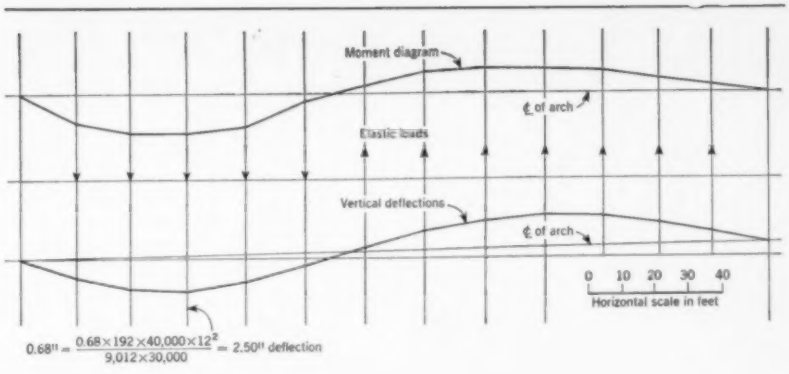
The load in the compression flange is 160 × 48.3/35.0 = 221 kips. If half the load is carried on the milled ends, the load in the flange rivets is 221/2 = 110.5, and the required number is 110.5/18.04 = 6.1 rivets. The allowable stress on the milled surfaces is 30 kips per sq in., so the area is adequate.

Fabrication Requires Precision

The greatest problem of fabrication was to obtain the necessary precision in the milled ends of the 18-ft sections so that the assembled arch would conform to the required curvature. It was at first hoped that several lengths of members could be milled at one time, but this was not possible. It was necessary to mill the sections one at a time.

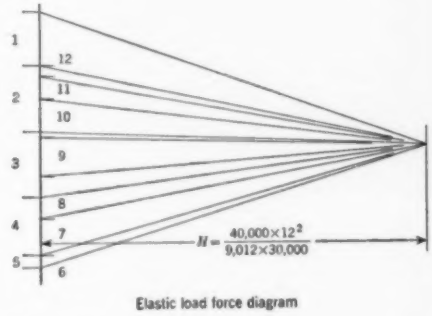
A template was made to the required curvature by the machine shop and all the sections of one arch were milled. This section was assembled flat in the yard and was found to be off by a chord length of 9 in. This error was due to the template maker's lack of appreciation of the precision necessary to achieve the desired result. The template was remade with greater accuracy, profiting from the experience obtained from the first assembly. The sections used in the first trial were not remilled, but were used individually in each of the other arches.

At the request of the erector, the 18-ft sections were not riveted to-


Moment diagram
℄ of arch
Elastic loads
Vertical deflections
℄ of arch
0 10 20 30 40
Horizontal scale in feet
$0.68'' = \frac{0.68 \times 192 \times 40{,}000 \times 12^2}{9{,}012 \times 30{,}000} = 2.50''$ deflection

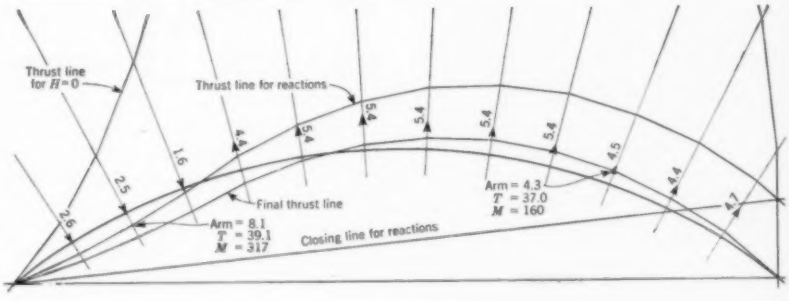
Elastic weights

Point	M	L	ML
1	−280	19.2	−5,470
2	380	18.0	−6,830
3	380	·····	−6,830
4	330	·····	−5,940
5	− 70	·····	−1,260
6	+ 70	·····	+ 1,260
7	+ 200	·····	3,600
8	240	·····	4,320
9	230	·····	4,130
10	220	·····	3,960
11	130	18.0	2,340
12	60	19.2	1,080



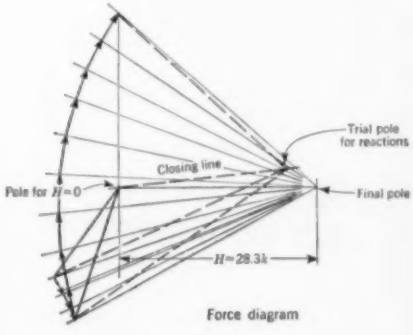
Elastic load force diagram

FIG. 3. Semigraphical method is used to determine vertical deflection of center line of arch.



Point	M for $H=0$			y	L	ML_y
	Arm	Thrust	Moment M			
1	6.6	15.7	104	11.9	19.2	24
2	16.0	16.8	269	20.7	18.0	100
3	27.5	18.5	509	27.8	·····	255
4	40.2	19.7	790	33.4	·····	473
5	63.2	16.2	1,025	37.0	·····	682
6	96.0	12.2	1,170	38.7	·····	815
7	135.0	9.3	1,260	38.7	·····	875
8	118.7	10.1	1,200	37.0	·····	800
9	81.9	13.7	1,120	33.4	·····	561
10	55.2	17.7	978	27.8	·····	490
11	34.1	20.6	702	20.7	18.0	262
12	16.5	24.3	401	11.9	19.2	91
					Total	5,428

$H = \frac{5{,}428}{191.86} = 28.3$



Force diagram

FIG. 4. In semigraphical analysis for wind loads, moments at design points are obtained by scaling distance of thrust line from arch and multiplying by thrust.

First two arches are shown (left) during erection. At request of erector, to facilitate handling at site, 18-ft shop sections were shipped unassembled. At site, half the length of each arch was assembled and riveted together on floor of field house, then raised into position. First erection method tried was to erect entire arch at one time, using two cranes. Because of torsional flexibility of beam section, a kink developed in one of 18-ft sections, shown below, so this erection method was abandoned.

gether in the shop, so that they could be handled more easily in the field. Half the length of the arch was assembled on the floor of the field house. The last arch on each end was assembled on the horizontal floor of the grandstand section before the sloping girders of the bleachers were erected.

As will be observed from the diagrams, the arch was designed with hinges at the springing line. Structures of this type are sometimes detailed with a pin at the crown to permit erection as a three-hinged arch. After the arch is closed, the flanges are connected and the hinge eliminated. A three-hinged arch is easier to close but requires the extra detail of the pin, which ultimately becomes unnecessary and is discarded.

The arch for the Wyoming Field House was designed without a crown hinge on the assumption that the erection could be done in a single unit or in three units, as the erector desired, and that, if the hinge was really necessary, the fabricator would ask for it.

The erector's first scheme was to place two construction towers approximately at the third points of the span so that the cantilever overhang would not overstress the arch section. The arch was to be placed one half at a time, the ends of each half being jockeyed into place by jacks at the top of the tower. The halves were then to be joined by the web plates and flange splice plates, using drift pins.

A second scheme was to erect the entire arch all at once, using two cranes. This scheme was attempted first but resulted in unmanageable sections because of the torsional flexibility of the beam section. On the first attempt the beam buckled and put a kink in one of the 18-ft sections. Restraightening was a relatively easy matter because the rivets could be cut out, the piece disconnected and sent to a local fabricating shop. The arches were finally erected by the first method using a construction tower on one half of the arch and cranes on the opposite half. No particular trouble was experienced in getting the arch sections to join.

The general contract price for the whole building, not including a few minor extras, was $1,093,329. The breakdown of costs for structural steel is as follows:

A-frames	45 tons at $255	= $11,475
Arches	175 tons at $270	= $47,250
End walls and head houses. .	116 tons at $280	= $32,480
Roof framing . .	78 tons at $245	= $19,110
Miscellaneous (balconies, lintels, etc.) . . .	165 tons at $292.32	= $48,232

Thus the total cost for structural steel to the owner, including erection, contractor's overhead and profit, was $158,547.

Supervising architects for the University of Wyoming Field House were Frederic Hutchinson Porter and R. Walter Bradley of Cheyenne. Plans were prepared by Leon C. Goodrich and Jan Wilking, associate architects, of Casper. The general contractor was Speigelberg Lumber Co. of Laramie. Structural drawings were prepared by Milo S. Ketchum, A.M. ASCE, Consulting Engineer, Denver, Colo. The subcontractor for fabrication of structural steel was the Omaha Steel Co., Omaha, Nebr. The erection contractor was Foster-Smetana Co., also of Omaha. The writer is indebted to John D. Griffiths, M. ASCE, District Engineer, American Institute of Steel Construction, Omaha, for many valuable suggestions on the structural design.

Successful erection method utilized tower (lower left, in distance) on one half of arch and cranes on opposite half. Tower was placed at third point of span so that cantilever overhang would not overstress section. Arch halves, placed singly by crane, were jockeyed into place by jacks at top of tower, then joined by web plates and flange splice plates, using drift pins.

J. N. GOODIER

Professor of Engineering Mechanics, Stanford University, Stanford, Calif.

Applied mechanics specialist is consultant to engineers

What does the specialist in applied mechanics do? He is not known by as familiar a designation as engineer, physicist, mathematician, or chemist. If he seems to stand in need of some delineation, it is perhaps because he is not so much an engineer, or even a consulting engineer, as he is a consultant to engineers. He maintains and cultivates a science and method which can answer certain questions engineers need to have answered, and he finds this a full time occupation in itself.

Archimedes, whom I take to be the founder of this branch of applied science, gave it an auspicious send-off with spectacular engineering triumphs. In response to King Hiero's request to show some great weight "moved by a small engine," he contrived a block and tackle with which he himself drew a loaded ship out of a dry dock "in a straight line as smoothly and evenly as if she had been in the sea." He later repudiated this phase of engineering in favor of its rival, pure mathematics, in accordance with Plato's conception of geometry as dealing with "unembodied objects of pure intelligence." Through the former he remains our example, having secured first a grasp of principle, seen its possibilities in application, and communicated the essentials of the matter to the actual constructors.

Archimedes achieved many of his spectacular triumphs by means of what is now elementary mechanics. In modern engineering there is of course a daily crop of problems likewise elementary. To solve these problems with confidence—all but the simplest—demands a continuing familiarity with the subject to a degree the busy engineer with varied responsibilities is not likely to maintain. In any sizeable engineering group a specialist in problems of applied mechanics will emerge or be recruited as soon as such problems are of frequent occurrence.

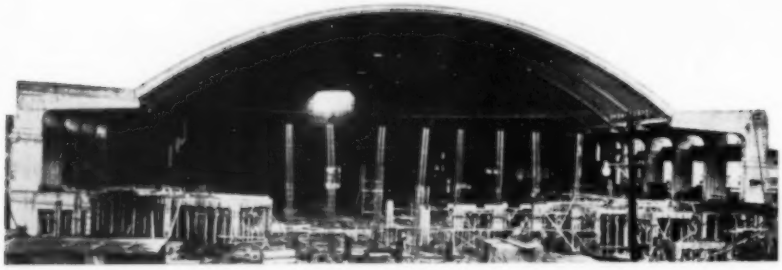
This emerging specialist is primarily an engineer. Yet as his problem solving activities grow he becomes a consultant, an adviser to the engineers who pose the problems and make the final decisions. It will probably not be long before he is asked questions which overstep elementary mechanics, perhaps about vibrations of railroad bridges, or earthquake resistant structures, or the reinforcement of holes in plates subject to fatigue, or concrete slabs on subgrades, or how the pressures developed in cavitation collapses can be measured, or what rules of similarity should govern the design of a model dam for strength tests, or a model wind tunnel for vibration tests. His more difficult technical problems will be largely exercises in the principal subjects of applied mechanics—dynamics and vibrations, elasticity and plasticity, hydro- and aerodynamics. These exercises would be at best troublesome, at worst formidably difficult, without the extensive labors of those scholar-engineers of Archimedean temper who have cultivated these subjects for engineering purposes. It is acquaintance with the fruits of these labors, together with the governing engineering interest, which distinguishes the expert in applied mechanics from the pure mathematician or physicist.

These principal subjects of applied mechanics are based on classical mathematical physics. With the extension of industrial scope and method, they came to answer more and more questions in engineering while in physics itself their significance diminished. The elastic solid theory of the luminiferous ether has gone, but the theory of stress waves survives to elucidate engineering problems of impact, ballistic experiments, pile-driving, and geophysical prospecting. Kelvin's vortex theory of the atom was unsuccessful, but the Helmholtz vortex theory on which it rested is now indispensable to the understanding and calculation of fluid forces on wings and blades. There is no longer any interest in the calculation of the gravitational attraction of mathematically amenable shapes, but the potential functions which sprang from that interest are now a commonplace of applied mechanics and other engineering subjects.

Besides encountering harder problems involving him in advanced mechanics, we must expect that our emerging specialist will encounter some which as yet have no answer, or some for which existing methods seem inadequate, and which he may come to regard as a professional challenge. There are for instance those who find it unsatisfactory to design structures on the basis of elastic behavior when in fact they fail inelastically, and so seek to construct methods of analyzing the inelastic action—or those who inquire into wind-excited vibrations, or severe and sudden loadings, or into the almost fluid motion of the metal liners of shaped charges. When the mind gropes for a solution—I ought rather to say for a clear formulation of the problem first—and is encouraged by a small glimmer of light, the hunt is on, research is in progress, and there may be an outcome of novel and permanent interest. The investigator may not, in this day and age, feel quite the exaltation of Archimedes and leap out of his bath crying "Eureka," but he will want to have his result competently appraised and put on public record if found valid. He may have a definite answer to a definite problem, as Saint-Venant had for the torsion of bars of noncircular section, or he may have the vital first step towards definite answers of the future, as Navier's original formulation of the differential equations of elasticity, or the several efforts beginning with Tresca's and Saint-Venant's to formulate a law of plastic deformation.

We must not lose sight of the fact that the practitioner of applied mechanics has his own scientific interest as well as his engineering work and interests. The immediate justification of his acceptance within the engineering fold is his daily problem-solving for engineers. But he cannot neglect his opportunities to add to the scientific resources he draws upon day by day, and surely it is best that he should find companionship for his second nature, as well as his first, within the profession and in particular within his engineering society.

(Prepared from Prof. J. N. Goodier's address before the inaugural meeting of the Applied Mechanics Division presided over by Prof. L. E. Grinter, Division Chairman, at the ASCE Annual Convention in New York.)



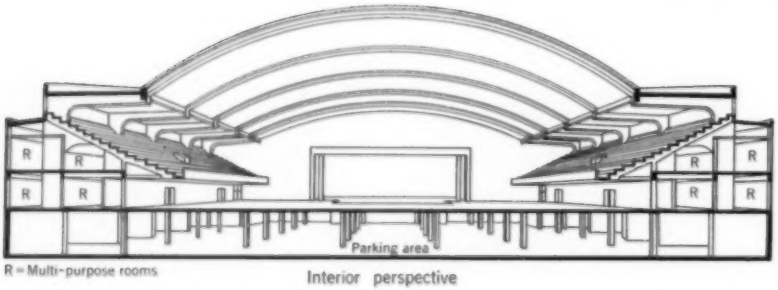
Onondaga County War Memorial Auditorium has thin-shell arched roof springing from ends of cantilevered frames. Dead load of roof balances horizontal thrust of barrel frames. When barrel was decentered, ends of cantilevers showed no movement. Relation of seating and meeting rooms to auditorium is shown in interior perspective, below.

Cantilever frames support thin-shell roof

BOYD G. ANDERSON

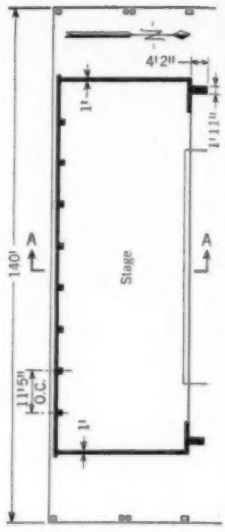
Ammann & Whitney,

New York, N.Y.

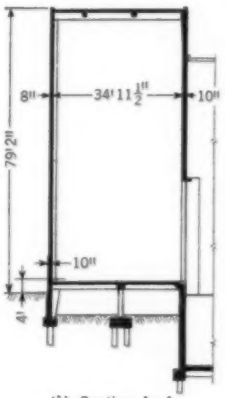


R = Multi-purpose rooms

Interior perspective



(a)



(b) Section A–A

Many features of interest to engineers and architects engaged in the design of multipurpose auditoriums are found in the Onondaga County War Memorial Auditorium, recently erected in Syracuse, N.Y. For this building, where the many and varied activities include conventions, exhibitions, theatrical performances, motion pictures, concerts, and most types of indoor sporting events, architects Edgarton & Edgarton developed a highly practical solution by providing a flexible arrangement of facilities implemented by the use of movable acoustical curtains and by selective control of heating, ventilating and lighting.

Most of the design problems for such auditoriums are architectural in nature on account of the difficulties presented by the complex and conflicting requirements of their varied uses. However, many interesting structural problems also develop because of the clearance requirements and space arrangements needed to satisfy the numerous functional needs of the building. Perhaps the most novel structural feature of the Onondaga Memorial is the auditorium roof, which consists of a slender, thin-shell barrel of 160-ft span, carried by cantilever frames supported on long concrete piles.

Structurally, expansion joints divide the Memorial into three separate but abutting buildings—a stage house, a memorial hall, and the main auditorium (Fig. 1). Reinforced concrete, used to frame all parts of the three buildings, takes the form of rigid frames, hipped plates, framed membranes, and thin shells.

The stage house, forming the south closure of the auditorium, consists of a reinforced concrete box 140 ft wide, 35 ft deep, and 75 ft high above the stage level (Fig. 2). The box is formed by 12-in. reinforced concrete walls on the east and west sides, 10-in. concrete walls on the auditorium end, and 8-in. concrete walls with a $2^3/_4$-in. precast veneer on the exposed south side. The south side wall of this box is stiffened by vertical pilasters spaced 11 ft 5 in. on centers and extending from the foundations to the roof, where they join the roof beams to form a frame, the far end of which is supported by the proscenium girder. These pilasters act to provide local stability to the thin walls and to transmit local dead and live loads to the skin of the box structure, which then acts as an integral membrane

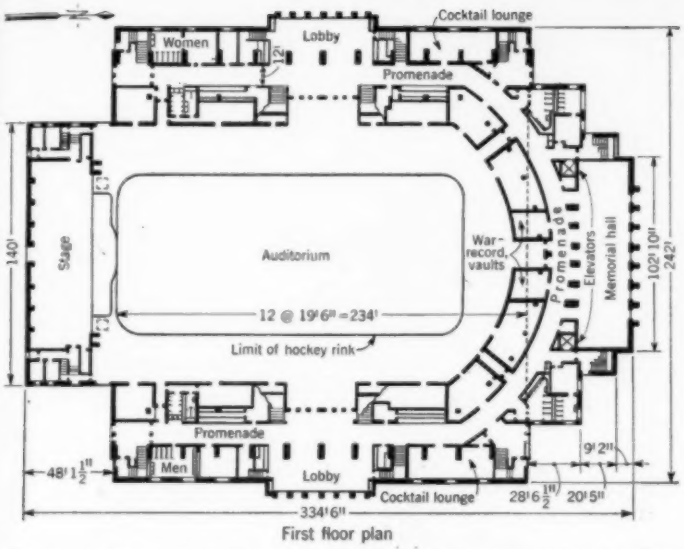
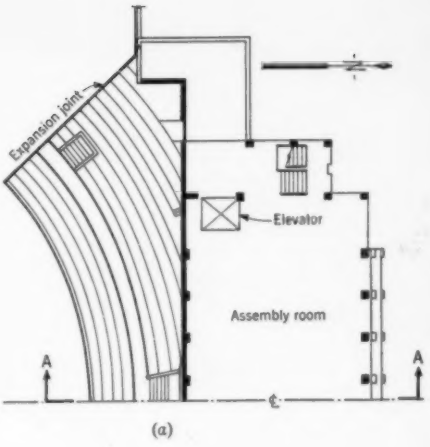


FIG. 1. Multipurpose auditorium provides facilities for conventions, exhibitions, theatrical performances, sporting events and other activities involving mass audiences or participants.



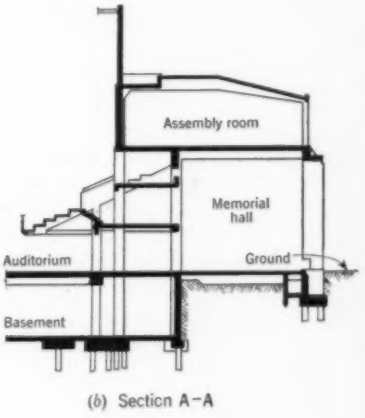


FIG. 2. Plan (*a*) and section (*b*) show general dimensions of stage house. Because of its relative rigidity, this structure is physically separated from arched auditorium by expansion joints.

FIG. 3. Plan (*a*) and section (*b*) of memorial hall show how part of auditorium seating is carried in north closure structure. As in stage house, this structure is physically separated from auditorium by expansion joints.

in delivering the loads to the foundation. Large 2 × 5-ft pilasters on each side of the 85 × 28-ft proscenium opening, serve to carry the upper proscenium wall and to stiffen the walls on each side of the proscenium opening.

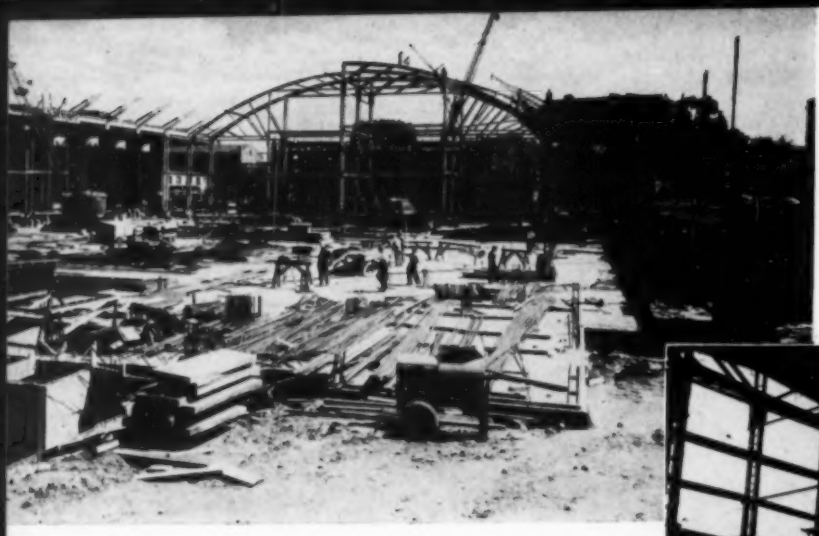
The memorial hall, closing the north end of the auditorium, consists of the memorial hall floor, the upper assembly room, the end auditorium balconies, and the north-end closure wall of the auditorium as well as the stair and elevator shafts and other miscellaneous rooms within the same area (Fig. 3). The structure is supported by rigid frames except for the minor beam-and-column assemblies around the stair enclosures.

The roof of the main auditorium consists of a thin-shell reinforced concrete barrel, flanked by rigid cantilever frames which support the barrel and complete the roof over the 205-ft clear span. The cantilever frames in turn pass down the sides of the main auditorium and bear on pile foundations. Smaller multipurpose meeting rooms are constructed of light reinforced concrete members which frame into the same rigid frames that carry the roof. The auxiliary columns around the exterior of the multipurpose rooms are largely light 8-in.-deep concrete posts.

Structures Physically Separated

As the framing of the stage house and memorial hall is relatively rigid compared to that of the main auditorium, continuous vertical joints were provided in the walls to ensure the physical separation of the auditorium area from the end structures. The closure between the auditorium and the end structures was made with precast units spanning 12 ft between the rigid end structures and the more flexible ribs of the barrel.

The type and shape of the structural framing for the auditorium were selected after careful study of the architectural requirements as they affected the structural geometry and strength. While certain vertical heights were required along the side walls to clear the upper rows of the balcony, a flat truss spanning the auditorium at these levels would have been not only heavy and expensive but also psychologically depressing to those seated in the balcony. On the other hand, an arched barrel rising from the sides above the balcony seats would have enclosed a larger volume of space than needed and



Cantilever frames were poured separately from reinforced concrete roof barrel. Forms for cantilever frames spanned two bents and were reused, one form being moved along each side. Falsework and forms for roof barrel are being erected in center of photo.

Falsework for main barrel is exceedingly light, consisting of two timber trusses for each rib. Falsework is moved on car wheels rolling on tracks under each line of posts.

would have resulted in structural difficulties in the columns and pile footings because of the greater thrusts caused by the longer barrel span. The adopted framing, which consists of a light, reinforced concrete barrel supported by cantilever frames, provides the optimum architectural effect at minimum cost and minimum volume. It also has many structural advantages.

By reducing the span of the arch barrel to 160 ft, or approximately the distance between inflection points of a rigid frame spanning the entire opening, the thrust of the barrel, the horizontal component of which is taken by the first floor acting as a tie, is reduced to almost half the value that would result from a barrel spanning the full width. The effect on the rigid frames outside the point of inflection is even more marked. The arched part of the roof, composed of a 3-in. shell supported by 24 × 22-in ribs at the center line and 32 × 22-in. ribs at the springing line, represents a minimum-weight construction, and the horizontal thrust of the barrel acts to relieve the moment caused by this light vertical load. Compared to the effect of a barrel spanning between exterior walls, the barrel thrust, as well as its eccentricity at the supporting foundation, is greatly reduced.

Both the basement and the first-floor slabs are designed for heavy truck loadings so that exhibition equipment can be moved directly into the building. The first-floor spans are relatively long to provide the necessary truck clearances in the basement and are heavily reinforced to carry the resulting wheel loads. Therefore the floor slab is well suited to act as a tie for the arch thrust, and considering the unlikely possibility of simultaneous overloads occurring in both the floor and the roof structures, the reinforcing steel required for local floor loads could carry both the arch thrust and the local floor load with a substantial factor of safety. Actually, a condition assuming full dead and live load on both the floor and the roof was provided for in the design, allowing a slightly higher working stress for this loading condition. This design procedure resulted in minor increases to the local steel in the first floor.

As the basement floor is below ground-water level, a drainage system with sumps was provided to reduce the possibility that a head of water would act on the basement slab. As a further precaution, the slab was anchored to the pile caps and was designed for a reversal in loading. Piles were driven at the diagonal midpoints between the footings of the first-floor columns to reduce the span of the basement floor, which was designed as a flat slab.

Because of the low bearing capacity of the soil, the main framing, columns, and basement floor are supported on pile foundations. Although piles could easily be driven to a depth of 50 ft where end bearing supplied the necessary resistance, bulging and heaving of the soil during the insertion of the piles prevented the pile contractor from using the uncased concrete type of pile, which he preferred, and made it necessary to substitute concrete-filled steel pipe piles of 70-ton capacity throughout the structure. It should be noted that vertical piles were used to support the barrel frames and that these pile groups were placed eccentric to the axis of the frame leg so that the overturning moment due to the barrel thrust is carried as an axial load on the piles, as shown in Fig. 4.

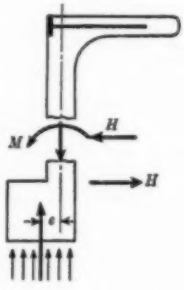
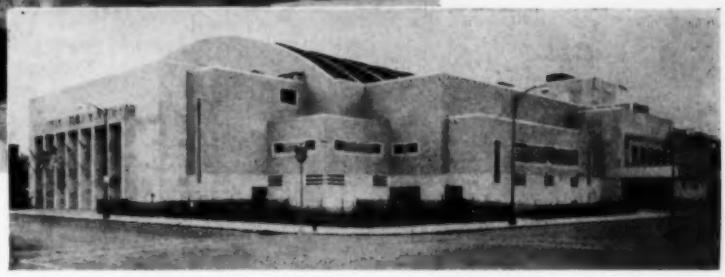


FIG. 4. Barrel thrust is carried as axial load on pile groups.

Construction Methods Described

Construction methods were conventional in most respects except for the method of placing the precast finishing panels on the stage

Photos courtesy John Fiocka



Completed structure provides required clear span necessary in any auditorium. Combined cantilever frames and reinforced concrete barrel provide necessary vertical clearance over seats without enclosing too large a volume of space. Structure also provides optimum architectural effect at minimum cost.

house and the method of forming the cantilever frames and shell barrel.

The concrete in the stage house was poured in 8-ft lifts. The contractor set 8-ft × 8-ft × $2^3/_4$-in. precast concrete slabs before the wall was poured and used these slabs as outside forms. Horizontal wales placed outside of the precast slabs were tied and strutted to the conventional inside wall forms through the joints in the precast slabs. With this method, a minimum of bracing to the side walls sufficed to align and stabilize the precast walls and forms until the stabilizing roof slab was in place.

Movable scaffolding was used for both the cantilever frames and the arch barrel. To facilitate the cantilever forming, a section of falsework spanning two bays was provided for each side. After each pour this falsework was lowered sufficiently to clear the edge beam on which the shell would eventually rest, then moved parallel to the frames toward the center of the building until the falsework was clear of the cantilevers. Next the falsework was moved along the long axis of the auditorium to the succeeding position and moved back to the line of the cantilevers, where it could be jacked into position for the following pour. The falsework moved easily along the first-floor slab on waste sections of steel pile casings which acted as rollers.

The cantilever frames were poured several weeks before the arch-shell portions of the roof were constructed. The main barrel falsework was exceedingly light, consisting of two timber trusses at each rib, each truss being supported by four lightly braced posts. All jacking was done at floor level using a jack on each side of each post. The falsework moved on car wheels rolling on tracks located under each line of posts. Each pour, with the exception of the first, took less than eight hours, and the final pour was completed in approximately six hours.

Space for utilities was provided largely in the clear area below the roof of the multipurpose rooms along each side of the auditorium. Ducts run laterally from this space to the auditorium through the space between the cantilever ribs and below the cantilever slab.

Outlets for electrical power for lights and electrical equipment were provided in the service galleries located at the springing line of the barrel, while conduits buried in the concrete of the ribs supply current for the general lighting, furnished by incandescent fixtures located along the soffit of the barrel.

Although lightweight access runways could have been placed under the barrel surface without detriment to the interior appearance of the shell, and exterior service galleries would have provided direct access to lights and inserts, the adopted layout was preferred and is believed to be completely satisfactory. Access to the lights and to the general utility inserts is provided by a mobile high-lift truck.

Behavior of Structure Observed

The behavior of the main auditorium frames is probably of particular interest as a measure of the validity of the assumptions and analysis used in the structural design. The final average vertical deflection at the center line of the barrel was approximately $1^7/_8$ in., as compared to the camber of 2 in provided for in the design. The ends of the cantilever frame deflected about $^3/_8$ in. downward when the frames were decentered. This position did not change when the barrel was decentered, as the vertical and horizontal reactions of the barrel had a balancing effect on the motion of the ends of the frame.

Edgarton & Edgarton of Syracuse were the architects for the project, with Ammann & Whitney and Robson & Woes furnishing the structural, and the mechanical and electrical, designs respectively. The W. E. O'Neil Construction Co. of Chicago was the general contractor, with William C. Pahl acting as superintendent of construction. Overall supervision of construction was under the direction of H. Vincent Edgarton.

Making "the breaks"

ARTHUR R. PELL, Personnel Manager,
North Atlantic Constructors, New York, N.Y.

Qualified engineers do not have too much difficulty in finding jobs these days as there is no shortage of openings at the lower salary levels. The competition for vacancies in high paying, highly responsible executive engineering positions, however, is still keen.

Why do some men move easily from one good job to another, while others of equal ability and technical skill find great difficulty in acquiring new positions at higher salary levels?

As personnel manager of a large construction firm, I know of engineers who have held positions paying annual salaries of $15,000 to $25,000 but who, on completion of the projects on which they were engaged, were unable to remain at that income level. I have also interviewed countless others who never could reach the $10,000 mark, even though their technical competence equaled that of their more highly paid colleagues. Most men in such circumstances attribute the difficulty to "bad breaks." Are they right? To some extent "breaks" have a good deal to do with success, but the entire matter cannot be explained so simply. Let us take a specific case.

John Lewis and William Smith are both civil engineers who graduated about twenty years ago from top schools. Both have had various jobs in construction firms ranging from junior engineer to project manager; both see an ad in a paper for "Project Engineer—Salary $15,000 per year"; both meet the specifications listed and answer the ad. John Lewis receives no reply. Smith is called for an interview and subsequently gets the job. Did William Smith have a better break, or was there another factor involved?

When Lewis answered the ad, he wrote a résumé covering his background. He had no idea how to handle this problem and naturally resorted to what he considered the most thorough method. He started by describing his schooling and then listing all his positions chronologically covering every month of his life from graduation to the present time. He worked long and hard at it, typed seven pages of single-spaced data, and mailed it in.

Smith took a different tack. He had given much thought to the résumé problem and had consulted a personnel specialist for advice on the best method of presenting his experience. He was advised to write a "functional" résumé, which would bring out the highlights of his career. This covered only one typewritten page and stressed, not where he had worked, but what he had done.

When the personnel manager who had inserted the ad received the replies, he had thirty to forty résumés to review. As a busy executive he had neither the time nor the interest to read seven-page histories giving little information except names of companies and dates. The functional résumé of William Smith stood out as different, concise, comprehensive and readable. So was it odd that Smith was called and later hired? Was this just a "break?"

The functional résumé is a comparatively recent development in personnel techniques. It is the result of extensive experimentation to find the best method of presenting work histories. Like John Lewis, the average man, be he business executive, technician, or engineer, is an expert in his own field but is not trained to present his abilities in words. Even a salesman, who can sell his product, often cannot sell himself. An engineer, who is certainly not expected to be able to write copy to sell anything, especially lacks this type of training and preparation. In the larger cities, personnel consultants are available to help applicants write the best possible résumés of their background and experience. For best results, it is advisable to utilize the services of such a specialist.

Sample Résumé Stresses Functions Performed

William J. Smith
5660 West 79th Street
New York, N. Y.
Tel: CO 9-2121

Twenty-five years of experience in the construction industry

Project Manager:

In complete charge of all phases of construction and administration on multi-million-dollar CPFF airbase project. Work included large-scale earthmoving, concrete aprons, asphalt runways, hangars, P.O.L. facilities, barracks, warehouses, and power plants. Coordinated construction planning, procurement, and operations. Provided top-level direction for several thousand field and office employees. Cited by Corps of Engineers for completing project ahead of schedule and below original cost estimates.

General Superintendent:

On various heavy construction and building projects, including highways, dams, and industrial buildings. Planned jobs, aided in preparation of estimates, supervised work in the field. Responsible for efficient use of contractor's equipment and personnel. Set up job cost-control procedures which resulted in substantial savings.

Field Engineer:

Directly responsible for conformance with plans and specifications of $500,000 industrial building group and $1,150,000 hospital. Supervised work of survey parties. Liaison with architect-engineers.

Office Engineer and Estimator:

For medium-sized general contracting firm. In charge of all office engineering functions including material takeoffs, design of forms and shoring, labor estimates, and final preparation of bids. Maintained material control and quantity records. Established system of processing shop drawings and bills of material which saved firm 30 percent of time needed for this work. Supervised and trained junior engineers and draftsmen.

Miscellaneous:

Age: 50 Married 2 children
B.S. in civil engineering from Cornell University (1930)
Member: American Society of Civil Engineers
Published: "The Contractor's Responsibility on CPFF Contracts" (CIVIL ENGINEERING, March 1946)

If the services of a personnel consultant are not available, and you have some gift for verbal expression, you can try writing a functional résumé yourself. The first step is to analyze yourself to determine your strongest points. Remember that the personnel man is primarily interested in what you can do and the qualifications you have which will contribute to the success of his firm.

I have found that generally the best way to pick out such strong points is to examine each job held in the past. Jot down the exact nature of your work and enumerate each important function you performed. List the suggestions you made which improved the efficiency of any operation. If such contributions are measurable in terms of money or time saved, state these figures. Indicate the scope of your responsibility for money, for personnel, for technical matters, and for policy making.

After you have done this for each job, pick out the major functions in each job which indicate the basic nature of the work, and list them separately. Briefly describe these functions. Remember that you may and should combine the functions which are inherent in several jobs. If you were an office engineer in three different jobs, you need only list the function "office engineer" once and describe under it the pertinent highlights of all three jobs.

Each paragraph of your résumé should cover one major function. It should describe your special assets and achievements in that function. Mention the size of the jobs on which you worked, if it is significant. Mention special equipment used, special problems faced and how you solved those problems.

List in a separate paragraph your education, degrees, special technical courses, licenses, memberships in professional organizations, and any articles or books you have had published. Photographs should not be sent unless specifically requested.

One of the most common errors in résumé writing is to list all the jobs held. Unless the firm for which you worked is a well-known organization the name of which will enhance your prestige, or unless it does a special type of work well known to everyone in the industry, there is no need to name it. If an employer is interested in you after reading your functional résumé, he will give you an application on which to list company names and addresses so that he can check them. Until he does this, the listing of firm names serves no important purpose and, in fact, diverts the reader from the important, functional points of the résumé.

The personnel manager or chief engineer who will eventually receive your application is a busy man. He is not interested in extraneous matters. He wants to know what you can do. He is concerned with facts, not with biography. He has read too many résumés that start, "In 1906 I helped my father on his farm."

The perfect résumé, therefore, will stress functions and accomplishments. It will be written in a concise manner which will stress the items in your career which best show your qualifications for a particular job. It should not cover more than one typewritten page.

It is advisable to write separate résumés for each type of job in which you are interested. One résumé might emphasize your field experience, another your office background. When applying for a specific position, select the appropriate résumé for that particular job. If you know the name of the company in which the vacancy exists, it is often wise to try to learn something about its operations and organization. A résumé specially compiled to fit its particular needs would be most effective.

The accompanying sample résumé (facing page) indicates one good method of putting your experience and background across in an effective manner. Study it. Use it as a model. Remember that a résumé is a personal thing and each man must tailor his own to suit his background and personality. If possible utilize the services of a personnel consultant to point out the highlights of your career and to present them in the most effective manner.

A very brief letter of transmittal, containing no more than two or three paragraphs, should accompany the résumé. A long letter might easily nullify the effect of the best planned résumé. A good letter might read as follows:

Gentlmen:

In response to your advertisement in today's Times *I am submitting herewith a résumé of my background and experience.*

I would appreciate the opportunity of showing you some of the work I have done and of discussing with you my potential value to your firm.

Very truly yours,
WILLIAM J. SMITH

Although a good résumé by itself will not win the job for you, it is a basic factor in determining whether you will be called for an interview. Obviously many résumés are received but only a very few applicants are called. A résumé prepared along the lines described will draw attention to your qualifications and show in a minimum of words how you differ from others competing for the same job.

The effort and time given to writing a good résumé, or the fee paid to a professional personnel consultant for writing it, will pay off in the long run by making "the breaks" which spell the difference between success and mediocrity.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

In shoring up a wall, the blocking was brought up flush with the bottom of the wall before disturbing the old foundation. Although the shoring was ample in amount and was well bedded, the wall underwent settlement and cracking when the old footing was removed and the shoring took the load. Why? For solution, see page 99.

EDITOR'S NOTE: This is the sixth installment of a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that in its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H.J.G.

Deep sand-island caissons support Cin

Walter C. Beckjord Station incorporates noteworthy structural features

LEONARD V. SMOOT, Senior Engineer, The Cincinnati Gas & Electric Company, Cincinnati, Ohio

The third steam generating station of the Cincinnati Gas & Electric Co., completed in May 1952, is of interest especially because of its foundations, the river structures of which were built by means of caissons sunk about 90 ft to bedrock by the sand-island method. This type of foundation was believed necessary to carry the heavy loads involved and to provide security against flood conditions on the bank of the Ohio River.

This station, like the other two electric generating stations of the company, is located on the Ohio side of the river. The oldest, the West End Station, is in the downtown part of Cincinnati, and 20 miles downstream from it, to the west of Cincinnati, is the Miami Fort Station. The new station, the Walter C. Beckjord Station, is 18 miles upstream from the West End Station.

Need for Additional Capacity

When load growth in the area served by the company indicated the necessity for additional generating capacity, expansion possibilities were surveyed. At West End no further expansion was possible, and only one unit could be added at Miami Fort before the practical limit there also would be reached. Because indicated requirements for industrial expansion to meet the preparedness program would require from 200,000 to 300,000 kw, it was evident that a new plant was needed.

With an ultimate development of 600,000 to 800,000 kw of new capacity contemplated, the choice of the Ohio River as the source of condensing water was inevitable for it is the only river near Cincinnati that has sufficient flow to support a plant of this size.

Other factors influencing the choice of location were: (1) ample acreage to provide for coal storage, ash disposal, a step-up transformer station, future circuit rearrangements and routings, and elbow room between the plant and its neighbors; (2) a good harbor for receiving coal by barge, a method of shipment found successful at the other two stations; (3) a spot having the highest possible natural elevation in order to minimize the cost of flood protection; (4) a plain from which adequate groundwater for cooling can be economically obtained; and (5) a site from which transmission lines can be readily extended to desired points of connection with the present system. Several locations that appeared to satisfy most of the conditions were studied, and comparative costs were estimated to prove that the one chosen was the most satisfactory.

In the vicinity of Cincinnati, the Ohio River follows a primary channel about 1,500 ft wide in sweeping curves through a secondary channel about 4,000 ft wide flanked by hills 300 ft high. In the dry season, usually from June to January, the river remains well within its banks, but for the rest of the year it is not unusual for it to be out of its banks one or more times, and on one occasion it actually reached a stage of 80 ft at Cincinnati.

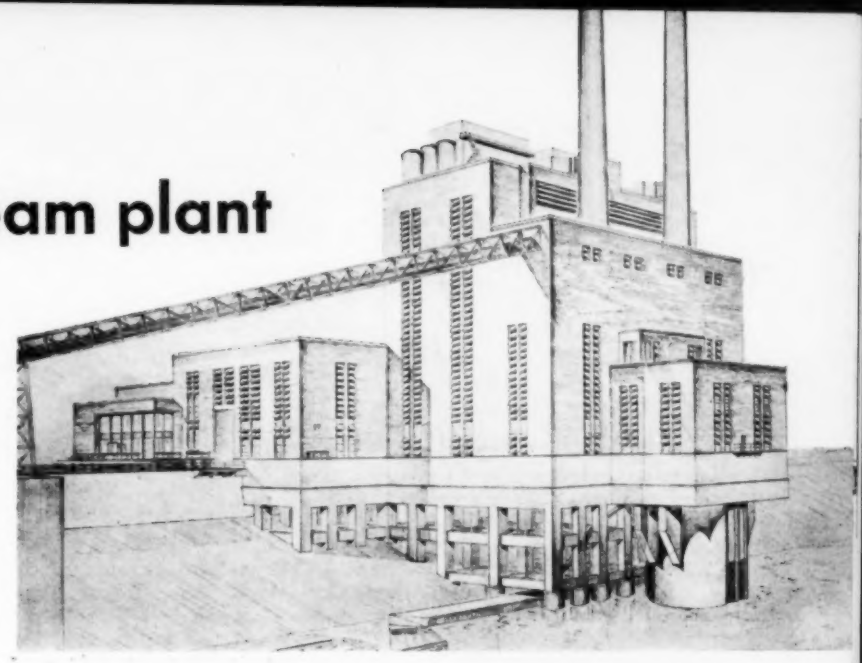
An investigation was made at the site to determine the general characteristics of the subsurface deposits, their capacity to take concentrated structural loads and to resist the shearing action that would result from a superposed earth fill sufficient to bring the general yard level above maximum flood stage. Sound rock was found to lie in a fairly level bed 90 ft below the general ground level and 40 ft below the bottom of the river. It is capable of taking loads far in excess of requirements. Immediately above the rock there is a 30-ft deposit of coarse sand and small gravel; above that a 25-ft layer of fine sharp sand; then a 20-ft layer of sandy clay; and finally a 15-ft layer of fairly firm clay topped with silt from recent floods. The driving and loading of test piles indicated that for best results the pile points should penetrate into the bottom layer of sand and gravel. Soil shear tests indicated that the fill could safely be supported on the surface without reworking the upper 15 ft of clay.

Open Caissons Chosen

Although these preliminary data suggested that the entire station be supported on piles, the nearness of the river, with its sloping banks, together with the need to provide river structures for coal and material handling equipment, led to the decision to support the boiler room and river structures on foundations landed squarely on the underlying rock. At the West End Station open caissons had proved very expensive because of subsoil debris and large glacial boulders, but at the Miami Fort Station this method was found to be more successful than the Chicago well and much less expensive than driving rings of steel sheetpiling. However, at the Walter C. Beckjord Station site, the extensive subsoil investigation indicated that the open-caisson method offered the greatest advan-

Cincinnati steam plant

Located on Ohio shore of Ohio River, 18 miles upstream from Cincinnati, Walter C. Beckjord Station of Cincinnati Gas & Electric Co. is shown as it will appear when two units are completed. First 100,000-kw turbo-generator unit began operation in May 1952. Second unit (far smokestack), for which structural steel is now being erected, is expected to be completed in 1953. Ultimate plant capacity is expected to be 600,000 to 800,000 kw.



Station plant for Unit No. 1 is supported on caissons, piers, and piles footed on rock 90 ft below ground level. Condensing-water intake well, 56 ft in diameter, for Units 1 and 2 also extends to rock. Caisson for intake to serve Units 3 and 4 is shown under construction at right. At left is partly completed equipment and coal-handling crane from which coal conveyor extends into station. Plant is designed to operate at maximum flood stage of river—30 ft above average ground level.

tages at the lowest cost for the river structures, and sheetpiling rings could be economically utilized for the boiler-room portion of the building.

The subsoil conditions and the proximity of the plant to the river influenced the general design of the main building. Suitable bearing to take concentrated loads is found at a considerable depth below the surface of the ground, but at that depth the bearing capacities are such as to meet the most severe requirements of power plant construction. These conditions favor a compact, vertical arrangement of equipment rather than a horizontal spread. Another factor is the possible maximum flood stage in the river, which might cover the existing ground level with 30 ft or more of water. The necessity of erecting supporting structures high enough to permit operation of the plant during such floods, when coupled with the need to go to great depths to obtain good footing conditions, was enough to settle the argument in favor of a vertical, compact structure.

Because the cost of a railroad spur to the plant was prohibitive, the engineers decided to use the Ohio River for barge shipments, and to install a crane of adequate capacity to handle the heaviest piece of equipment needed for the new station. However, this method of moving in equipment required a crane on the river with rail connections that would be available to do the loading. No such crane could be found. Consequently it was necessary to build a crane at the company's Miami Fort Station 38 miles downstream, where there is a rail connection for bringing in equipment. Two flat-top equipment barges were purchased to serve the double purpose of transporting the equipment and, when not in use

In progress view, Unit No. 1, at right, has substructure, including intake well, completed and structural steel on way up. Adjoining it, Unit No. 2 has piers, pile caps, and condenser pit in various stages of completion. At left, piles and intake well for Units 3 and 4 are under construction.

for that purpose, of forming part of the mooring docks at the two plants.

Since coal is to be unloaded from barges, it was found practical to design one river pier at the new station to support both the coal unloading crane and the equipment handling crane. Then, because the structure was at the river's edge and subject to both flood and ice gorges, it was taken down to rock, thus making it capable of supporting additional vertical loads. By using cantilevers at the top of the pier, the size was increased enough to make room for the coal crushers and the junction points of all coal conveyors, both into and out of the yard and into the building. This arrangement also influenced the decision to locate the main boiler plant close to the river.

Another example of the compact vertical arrangement of the plant is to be found in the circulating-water intake structure. To hold installation costs to a minimum, each intake is built to accommodate two condensing units. As the station expands upstream, parallel to the river, an additional intake structure will be required for each pair of units. The arrangement is such that welded steel pipe is used for circulating the water to the condenser and back, where it is discharged into a flume running parallel to the river in the rear of the intake well. Thus the warm discharge is not recirculated unless it is required for melting ice around the intake. It also serves to provide an ice-free harbor in winter since the barge fleet is downstream from it. The flume has a concrete bottom and top with the sides formed of MZ32 sheetpiling. It will be extended upstream as the plan develops.

It was decided to make the intake well an integral part of the plant. Although it is freestanding and circular in shape up to the basement floor level, above that level it is squared up on brackets to conform to the general plant design. It is lined up with the coal-equipment pier to form the harbor line. Because it too must take the load imposed by flood and ice conditions, and must extend high enough to keep the operating floor above extreme flood levels, its foundation was set on rock.

To arrive at the well shape, an economic study was made comparing the cost of sinking a square caisson as against a round one with a squared-up top section, which was chosen. The round part of the well contains the water chamber, the bottom of which is level with the bottom of the river, 31 ft above rock, with the intake properly screened by bar grilles, a traveling bar screen, and a traveling basket screen to take trash and debris out of the water.

The height of the intake structure is such as to accommodate vertical submerged pumps which eliminate the need for a large, deep condenser well to house the circulating water pumps, thus permitting the condenser well to be considerably smaller than is usual with such structures. Another advantage of this design is that the intake structure, because of its size and its ability to take heavy vertical loading, can house the water treatment plant, consisting of a cold-process sludge-blanket-type softener, a demineralizer for boiler makeup, and circulating-water chlorinating equipment. It also contains the service-water pumps, the treated-water pumps and the boiler-room ventilating equipment. This arrangement of equipment in the intake well reduced the space requirements in the main plant and correspondingly lowered the cost of the foundations.

The plant must be constructed to resist a maximum flood stage of 80 ft, but to raise the plant to that level would have made the foundation cost prohibitive as compared to partial elevation, with the remainder of the protection secured by flood proofing. The economic balance was reached by lowering the first floor 15 ft below the maximum flood stage of 80 ft and flood-proofing the walls and floors to provide for that height of water.

Placing Yard Fill

The area around the main plant, including the transformer station yard and part of the coal yard, is elevated on an earth fill 25 to 30 ft in depth. The fill for the first two units required 700,000 cu yd of clay borrowed from another part of the property. Eventually the borrow area will provide space for depositing ashes from the plant.

The fill was made in 8-in. layers and rolled with four to eight passes of a sheepsfoot roller at 350 psi under optimum moisture content for equipment of that weight. Compaction to 105 percent was normal, although the specified compaction was for at least 95 percent.

Intake-Well Construction

With the decision to make the intake well an integral part of the plant, it became necessary to locate the intake as accurately as the plant itself and to construct it concurrently with the other foundations. To locate the cutting edge as accurately as possible and to afford a working platform above normal river stages, a sand island 75 ft in diameter was constructed by driving a ring of steel sheetpiling and filling with river materials to an elevation 20 ft above pool stage. The cutting edge of the 56-ft-dia well was set and the well was sunk to rock in successive lifts by the open-caisson method. The bottom was cleaned off, inspected by a diver, and sealed with tremie concrete. The accuracy in sinking was such that the drift was only $2^1/_2$ in. and the rake only $^7/_8$ in. in 69 ft. This variation was corrected in the upper lifts.

The boiler-room piers were formed by driving rings of 60-ft lengths of

River pier in center of view supports outer end of bridge for traveling crane which will handle equipment to be brought in by barge. Building on pier contains equipment for unloading coal from barges and coal crusher. At left, conveyer leading to power station is under construction.

River-side equipment crane of 210-ton capacity was built 38 miles down-river from Walter C. Beckjord Station, at company's Miami Fort Station, especially to load equipment from rail spur for transportation by barge to new station. Here barge has been spotted to receive a load. Lack of rail facilities near Beckjord Station made it necessary to deliver heavy equipment to it by water.

M112 steel sheetpiling to rock from a pre-excavated level 58 ft above rock, or about 9 ft above pool stage in the river. This work was scheduled for the summer and fall months when the river is usually near pool stage. The rings were made up of either 18, 20, or 24 pieces of piling properly bent to form the desired size. The interior was excavated by clamshell bucket under a full head of water to eliminate the need for interior bracing. After inspection and cleaning by a diver, the cylinders were filled with tremie concrete. It was feared that driving such a distance through sharp sand might be impossible, but every sheet went down to rock. Only three out of 58 such rings opened up in one of the interlocks, because of obstructions, and these openings occurred where the piling had been driven in 5-ft successive steps around the ring instead of in the $2\frac{1}{2}$-ft steps which had been considered advisable.

Above the circular pier the columns were squared up and tied together in quadrangles at the 58-ft level and again at the 82-ft level before reaching the basement floor level 105 ft above rock.

Foundations for the part of the building containing the turbine room and service area, being more remote from the river and protected from scouring by the boiler-room piers and the intake-well caisson, are supported on either 25-ton or 50-ton cast-in-place step-tapered concrete piles. The piles, driven from different cutoff elevations depending upon the ground level, penetrated to variable depths into the sand deposits below. Those under the condenser well, and for the piers under the lower footings, were driven to within 7 ft of rock; the highest point elevation for the 25-ton piles which were driven from higher levels is about 27 ft above rock. The condenser well required 208 such piles and the rest of the building in the first unit, 495 additional.

Piles within 15 ft of those being driven were not permitted to be concreted until driving operations had ceased, and a time lapse was specified before driving could be resumed.

Piers for Cranes and Conveyors

The pier which supports both the coal unloading crane and the equipment handling crane, was constructed by the open-caisson method in a sand island and was sunk to rock in successive lifts following the same procedure as for the intake well. The pier measures 30 × 80 ft, has rounded ends, and is divided into three cells by interior walls. At the level 71 ft above the river, or 120 ft above rock, it employs several sets of cantilevers to support control equipment, a transformer

Cutting edge for intake-well caisson, 56 ft in diameter, is set on blocking on top of sand island built inside of ring of steel sheetpiles 75 ft in diameter.

bank, and dust collecting equipment for the coal handling installation. Almost half of the main pier is devoted to the support of the large equipment-handling crane.

Much of the material for the plant and the lighter equipment are transported by truck over the highways either directly from the manufacturer or from railroads in Cincinnati. Some of the equipment must be transported by barge because of its weight or bulk. At the time the equipment cranes were designed, the size of a unit at the Walter C. Beckjord Station had been set at 100,000 kw. However, before the installations were made, certain developments in the Cincinnati area indicated that turbo-generators of 125,000 to 150,000 kw might be installed in the future. The original design of the cranes, both that at the Miami Fort Station and at the Walter C. Beckjord Station, set the load at 125 tons with an overload capacity of 1.5 for a total lift of $187\frac{1}{2}$ tons, the estimated weight of the stator for a 100,000-kw generator. This loading plus 10 percent for vertical impact, a 10-percent longitudinal impact for traction, and a 5-percent transverse impact, was combined with a 30-mph wind to give the maximum loading.

At the Walter C. Beckjord Station, because of the infrequent handling of extra-heavy loads, stresses were permitted to approach the elastic limit of the steel in the bridge structure, including secondary stresses. In the Miami Fort crane the stresses conformed to the AISC Specification, not only because of the lower installation cost, but also because such a crane, with its railroad connection, might be useful along the Ohio River as the originating point for barge shipments to plants other then the Walter C. Beckjord Station. The traveling cranes themselves are identical at the two plants. It is only in the structural supports that they differ.

At the Walter C. Beckjord Station, the crane bridge span is 184 ft from the center of the river pier to the center of the land pier, a concrete bent landed on 50-ton piles. The additional travel on the river end, which permits the crane to move out over the barge, is 45 ft on a cantilevered bridge, and that on the land end, 35 ft on a similar cantilever out over a railroad track below. The bridge at the Miami Fort Station is only long enough to permit picking up the load from a flat car spotted immediately under it, with the same length of cantilever extending over the river as at the Walter C. Beckjord Station.

When it became necessary to consider loads of 210 tons instead of the $187\frac{1}{2}$ tons originally specified, both the cranes and the bridges were investigated with this change in mind. The cranes were only slightly affected, with not enough loss in safety factor to justify modification. The Miami Fort bridge was satisfactory for the 210-ton load with a slight reduction in the allowable impact loading, which could be offset by careful handling. In the case of the bridge at the Walter C. Beckjord Station, it was necessary to reinforce several compression members and their connections in the cantilever to take the new load.

The crane structure at the Walter C. Beckjord Station was erected under adverse conditions of terrain. The river stage was not high enough to permit the use of river equipment from below, but it could not be depended upon to remain low enough to permit the use of land equipment on the bank. Consequently, by utilizing two temporary bents, one under the land cantilever and one in the center of the long span, all the structure within reach from high ground was erected by crawler crane and the remainder with a derrick car traveling on the temporarily supported partial structure.

Coal Handling and Storage

Coal is brought down the river in barges which carry up to 1,000 tons each. Barges are tied up in a fleet which is controlled from the head boat of a four-unit floating dock owned by the Cincinnati Gas & Electric Company. Individual barges are floated into position under the coal unloading crane, which dips out of the barge by clamshell bucket and dumps into a hopper. This bucket handles 8 tons per dip. During the unloading activity, the barge is shifted back and forth by a pair of motor-driven winches to keep it on an even keel as the coal is unloaded. Coal from the tower hopper can be fed either to the yard-storage supply conveyor, or through either of two crushers to the conveyors supplying the bunkers in the building.

The coal conveyed to the yard is carried away to storage piles by rubber-tired 22-cu yd carryalls. This coal is later reclaimed by hauling back to a hopper which feeds a conveyor leading back to the coal crusher, and thence into the station.

In cooperation with local authorities, a high-level access road is being built from high ground across the lowlands to the plant. This road will be constructed on a levee 20 to 30 ft above the existing grade and will enable operating personnel to reach the plant in time of flood.

Sargent & Lundy, engineers, designed the plant, under the direction of the Engineering Department of the Cincinnati Gas & Electric Co. The foundation work was done by Raymond Concrete Pile Co. and Dravo Corporation as subcontractors under The Ferro Concrete Construction Co., the general building contractor for the structural part of the work.

Walter C. Beckjord Station is pictured as it will appear when completed for two 100,000-kw units. First unit was placed in operation in May 1952.

Prestressed concrete spiral staircase at G. Magnel's laboratory in Ghent, Belgium, below left, is similar to many staircases in reinforced concrete such as that shown at right, from Woodner Apartments, Washington, D.C. Number of reinforced concrete spiral staircases indicates that perhaps this type of structure does not require prestressing from point of view of either design or economics.

Is prestressing the answer?

JACOB FELD, M. ASCE, Consulting Engineer, New York, N.Y.

Prestressed concrete is now a very active subject—almost a fad—in civil engineering. Many special conferences are arranged to preach the new gospel, and as often happens with good ideas, the tendency is to oversell it. There are many merits in the technique known as prestressing and many uses in engineering design. However, it is important that the user be made aware of its limitations and warned that he cannot accept all statements about it at their face value.

About 1886, two men working independently, Jackson in San Francisco and Doehring in Germany, patented the technique of prestressing as applied to concrete. Almost half a century went by while their ideas incubated and then suddenly, about 1930, the subject moved into the limelight. More recently it has been advertised as a cure-all for the ills of reinforced concrete. The writer, while agreeing with many of the advertised merits of this new material, is cautious in using it without carefully considering the question mark which should be at-

tached to many of the properties usually taken for granted.

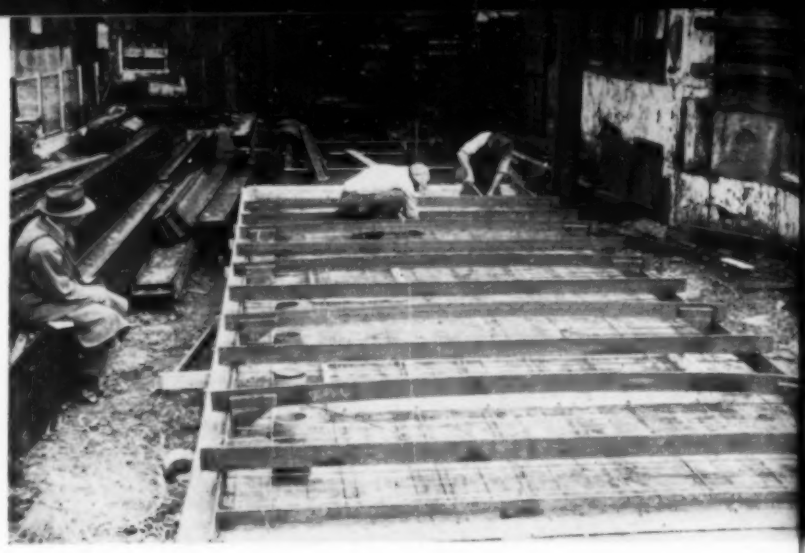
It should be realized that prestressing is not a new technique and does have centuries of performance to prove its value. For instance, when the first metal-rimmed barrel was made, a prestressed structure resulted. When the large domes of medieval days were built on scaffolding and tied with heated chains, which upon cooling imposed a ring tension that permitted the scaffolding to be removed, a very large and imposing prestressed structure resulted.

There is no doubt that prestressing technique should be used to provide the necessary properties to make a design possible when such properties cannot be obtained by other techniques or other materials at lower cost. There is no doubt that prestressing should be used when it will make possible a better design, or a less expensive one, taking into account future maintenance costs and the expected life of the structure. However, prestressing should not be used merely for its advertising value, or to glorify a patented item, or because of its novelty. It should not be adopted when dependent on unknown or uncertain properties, or to save in weight of materials without realizing a saving in the total cost.

When CIVIL ENGINEERING (September 1951, page 25) published an article by G. Magnel, M. ASCE, on the prestressed spiral stairway tested in Ghent and built in Antwerp, several correspondents pointed to similar stairways built of ordinary reinforced concrete (November 1951, page 56; February 1952, page 52; May 1952, pages 56, 58). There is a very fine example of a graceful spiral stairway of reinforced concrete in the dining hall of the Festival Building in London. The variety of examples noted by correspondents indicates that possibly this is a type of structure not requiring prestressing either from the point of view of design or from that of economics.

Basic Advantages of Prestressing

With certain other structures, however, the situation is different. Liquid and gas holders, for example, have presented a problem since it has been found almost impossible, with reinforced concrete, to provide tanks or barrels that are liquid tight. Here prestressing has obvious advantages and has also been found to be economical. As reported in the *Proceedings* of the August 1951 MIT Conference on Prestressed Concrete, and in many technical articles, prestressing techniques should supersede ordinary concrete designs in this field. Even if economy could not be proved, the better result achieved with prestressing would make the conventional reinforced concrete tank obsolete. Actually prestressing also has the edge in economy in this field. As an example of relative cost, the eight large tanks built for New York City at the Hunts Point Sewage Disposal Plant would have required 17,840 cu yd of concrete and 1,642 tons of reinforcing steel for a reinforced concrete design, while for the prestressed design finally adopted 11,060 cu yd of concrete and 474 tons of high-strength wire were used.



Where weather-tightness is necessary for exterior walls that are not to be faced with masonry, prestressing of concrete is an advisable method. Research work now in progress on the occurrence of cracks in two-way prestressed slabs and also in the very long assembly methods of multiple casting must be taken into consideration. When small units are used, no cracks are to be expected. The writer has had excellent results in prestressing wall panels up to 30 ft in length by 9 ft high. These walls, consisting of $1^1/_2$ in. of ordinary concrete on which was poured $1^1/_2$ in. of Aerocrete for insulation, have been exposed to exterior conditions in salt air and freezing temperatures and also to semi-tropical climate now for two years. They prove that prestressing can give an absolutely tight and impervious surface. Despite theoretical analysis to the contrary, the Aerocrete layer does not separate from the prestressed reinforced concrete sheet.

Prestressing in structures consisting of beams or girders, whether used for buildings or bridges, permits a reduction in the total thickness of members which realizes secondary economies, from a saving in story height in the case of buildings to savings in approach costs in the case of bridges. But these secondary savings in the case of many prestressed bridges are no greater than could be secured with a rigid-frame design.

Dangers Cannot Be Overlooked

A number of dangers must be kept in mind in using prestressed designs. Differences in deflections and deformations, where prestressed and ordinary concrete are combined in one structure, must be carefully considered. In a very large warehouse in Belgium, where the roof-supporting members are all prestressed but the curtain walls hanging from the exterior beams are of ordinary concrete, a considerable number of cracks are in evidence. Of course a similar difficulty arises in a reinforced concrete flat-slab design, where deep spandrel beams are constructed monolithically with the slab. Torsion cracks in the spandrel are chiefly caused by the difference in shape distortion of slab and spandrel.

It is usually realized by designers that the best way to eliminate this difficulty is to use a minimum depth of spandrel. Where deep spandrels are necessary for architectural or other reasons, they are best hung as independent short lengths of thin wall from the structural edge beam of the slab. In another warehouse designed later in the same area in Belgium, the spandrels were hung as separate sheets with expansion joints between them, and the cracks noted in the previous case never materialized.

Prestressed slab for housing units used only simple hand tools. Steel form and bracing are made of standard angles and wires are ends of bridge cable (far left). Slab consists of 1½ in. of ordinary concrete and 1½ in. of Aerocrete. Tension is put into wires by tightening small nuts on ends of wires (near left). Design tension is determined by tuning wires with a tuning fork of the proper period. Prestress is held by bond. Finished slab (below) can be twisted, bent, and generally mishandled without cracking.

Quite a lot has been written about the danger from corrosion of reinforcement in prestressed designs where the wires or cables are not fully embedded in the concrete. However, a more serious danger is the effect of high temperatures resulting from fires on a prestressed structure. The discussion by Lawson at the London Building Research Congress, and the paper by G. Barr at the Ghent Prestressed Concrete Congress, both in September 1951, covered this subject and were in agreement that some very serious deflections resulting from a complete redistribution of stresses are to be expected in case of a fire.

There is still extensive research going on to determine what change in both steel and concrete stresses results from plastic flow and temperature changes. It is now pretty well agreed that, especially for unbonded reinforcement, an imposed stress of 140,000 psi will, in a comparatively short time as compared to the expected life of the structure, become 110,000 psi. Probably the longest time tests are those reported by W. C. Voss at the MIT Conference on Prestressed Concrete in 1951. He found that the rod stress of 6,500 psi decreased 50 percent in one year. The consensus of opinion in research reports is that for higher stresses the loss can be assumed at 25 to 30 percent. The type of cable or wire steel used affects the percentage of loss, as was reported by W. D. Everling at this same conference.

Factors of Safety

The entire concept of a factor of safety must be modified in dealing with prestressed concrete. Actually this concept in prestressed concrete is very close to the concept in foundation design, where a structure that behaves as expected is safe and one that does not is unsafe. There is no true numerical measure of when a safe structure becomes unsafe.

Another parallel between prestressed concrete and foundation design is presented in the behavior of piles of various sorts. The prestressed bonded techniques correspond to true friction piles; the poststressed and unbonded reinforcement corresponds to true end-bearing piles; and when poststressed reinforcement is grouted in, we have an example of an end-bearing pile with some frictional resistance. A study of the literature on the transference of stress between piles and the earth surfaces in contact with them will indicate the difficulty of preparing a true and complete picture of stress transference from reinforcement to concrete. The factors of safety often indicated for prestressed designs do not take into account the localized high stress at points of contact between steel and concrete nor, in the poststressed design, are the extremely high compressive stresses at the anchorages properly accounted for.

It is comparatively easy to design reinforcement and to show theoretical positions for it. To obtain such accuracy in the field is another matter. On a certain job in Europe, the writer was quite shocked (and pleased) to find that the foreman in charge of the prestressing was using a 6-in. pocket rule to measure the elongation provided by the intricate jacking apparatus to determine when jacking was sufficient. Since these wires were some 60 ft long,

Curtain walls hanging from prestressed girders, as in this Belgian warehouse, crack when not properly separated from prestressed concrete by expansion joints. Warehouse built subsequently had curtain walls hung separately and showed no cracking.

embedded in a hollow preformed tube, and had been straightened out by hand from a reel, it is to be wondered whether the foreman was getting the result that the designer had expected. Such field procedures must be taken into account in designing and proper allowance made for varying degrees of compliance with the design requirements. In other words, the last kip of available stress in the reinforcement must not be expected.

Construction Methods

Use of precast units either fully or partially prestressed, or even with temporary prestress for construction conditions, seems to offer the most favorable method for this technique. Machine-produced, standard-size units have been found extremely economical where the plant cost can be absorbed by sufficient volume. However, the truth of this statement was recently questioned during the inspection of a very complete plant in use in Britain where the entire plant cost was a national subsidy, and even then prices for the products were competitive with reinforced concrete only when production schedules were full. Evidently a relatively small reduction in demand would change the economic picture. Depreciation and maintenance costs for such a plant continue even when production is low or negligible.

Another condition favorable to prestressing is large-scale repetitive field production, chiefly in precast work such as identical small housing, piles, modular sections for a large warehouse or factory, or identical spans on a long trestle bridge. As far as housing is concerned, it must be kept in mind that sales resistance to identical homes will largely offset such economy in private developments.

When it comes to a single, specially designed job, whether a building or a bridge, the economy of prestressed concrete is questionable, not only in this country but abroad as well, judging from conversations held with practicing engineers and contractors in recent years in England, Belgium, Denmark, Holland and Brazil.

Materials for Prestressed Concrete

The materials required for prestressing are concrete of better quality than is ordinarily expected in reinforced concrete work and special steels for reinforcement. Better quality of concrete can be obtained, and it is noteworthy that local organizations like the New York Concrete Industry Board recognize this problem and are trying to solve it from the production point of view. Reinforcing wires of very high tensile value, and cold-drawn, heat-annealed, special steel rods and cables of various types are available. Metallurgical developments in wires in the laboratory do not always provide the expected results in the field, delegates to the MIT conference were cautioned, and difficulties with the wires of the Detroit-Windsor and Mt. Hope suspension bridges were cited.

When high-strength rods or cables are used, the cost of the fittings and anchorages becomes an appreciable percentage of that for reinforcing material. Generally it is understood that a grip for a cable costs as much as 30 ft of that cable. With grips at both ends, the cost of a 30-ft cable obviously is tripled. Since machinery is available for pressing buttons on the ends of wires and for rolling threads even on very hard steel, as used by the writer in doing prestressing work for some small houses, the tensioning of wires by pulling up threads by either hand or impact wrenches seems to point to an economical solution. Where extremely high stresses are not desired, the cold working of ordinary reinforcing bars, either by stretching or by rotation, should be considered, together with either a friction or a threaded grip. Further development of the wire pulling grips used for wire installation in transmission work, to permit higher loads, would materially reduce the cost of proper fittings.

Where wires are bonded, the surface resistance to slip can be increased by special deformations or knurling. However, it must be remembered that this method reduces the section of the wire, and localized stresses decrease the maximum permissible load on the remaining cross sectional area. An attempt by the writer to increase bond resistance by permitting the wires to rust was not successful because, when the wires were stressed, the rust sheath came loose and separated completely from the wire.

Some research is necessary to determine whether there is true correlation between the strength of

concrete in the standard cylinder compression tests and its in situ strength after prestressing. There is so much difference in physical boundary conditions that the writer feels there is no correlation. Simpler methods are required to determine in the field the true stresses in the reinforcing and, probably more important, to find methods of equalizing the stress in the wires of each assembly. The writer found that a vibratory-period measurement of wires of equal length, cross section, and tension was not only cheaper than the use of any type of gage but permitted close equalizing of the stresses in all the wires of any unit. It was found, for instance, that if one wire vibrated, all wires carrying the same stress would vibrate in sympathy, and only those that did not, required adjustment.

Reference should be made to the detailed list of research problems now being studied in Britain. These relate to questions which have not yet been fully answered, as listed in the report of the British Building Research Congress (London, 1951). Reference should also be made to the work of Bureau Seco, "an organization to report on incidents" in Belgium where construction results do not agree with expected design.

It might be of interest to list some prestressing techniques in materials other than concrete, which are considered normal procedure. Every farmer who hogties the beams and rafters in his barn is prestressing the timber. A few other examples that come to mind are introducing camber in steel beams and rigid frames, sometimes to completely neutralize dead loads; putting ring tension in domes; getting upward deformations in forms by jacking; holding brick and tile floor arches in place by using pulled-up wrought-iron tie rods between beams; tying down the shore arms of cantilever bridges to the abutments; pretensioning the guy wires on towers to reduce wind flap; and introducing compression in subaqueous ring tunnel sections by jacking the shield.

What the Congresses Decided

Finally it is pertinent to quote from the resolutions which completed the congresses on prestressed concrete at MIT and at the University of Ghent, and to note how similar these were in content.

At MIT it was concluded that "it is now necessary to crystallize nomenclature and design criteria for prestressed concrete to avoid delay in acceptance of practical applications in construction, . . . prepare as soon as possible a proposed standard for nomenclature and design in such general form that it will not restrict the development of various known and future methods and their application to industry and construction."

At Ghent the resolution stated that "to promote the progress of prestressed concrete, it is important to know how concrete acts and to have all information concerning its general behavior.

"It appears desirable, besides making tests on the quality of cement and on creep of steel and concrete, to start new tests in this field, and to this end the Bureau suggests that the following resolutions be accepted, it being understood that a copy of them will be sent to the Reunion Internationale des Laboratoires d'Essais et de Recherche sur les Materiaux et la Construction.

"I. The International Congress on Prestressed Concrete of Ghent, 1951, desires that in the tests on concrete special attention be given to the following points:

(*a*) study of the elastic, plastic and viscous deformation of concrete

(*b*) effect of repeated and alternating loadings

(*c*) effect of variations in temperature and moisture

(*d*) deformation of concrete under shear

"Progress in the knowledge of the physical behavior of concrete will probably be more rapid if an effort is made to study the behavior of individual test specimens.

"II. The Congress suggests that the laboratories undertake tests on the cracking of slabs prestressed in two directions.

"III. The Congress asks Mr. Freyssinet to agree to coordinate the programs and to collect the results with the idea of presenting an overall picture.

"To avoid delaying progress in prestressing, the Congress recommends that the tentative Regulations on Prestressing be sufficiently elastic to allow engineers who apply the most recent scientific knowledge to obtain waivers to these specifications whenever they are justified.

"Finally, the Congress desires that a system of international notations be worked out to simplify the reading of papers."

Accuracy of position in prestressing cables is hard to obtain. Photo shows true shape of bent cables in a prestressed girder built by one of Europe's most experienced contractors.

Add-area method extended to include composite sections

DEWEY M. McCAIN, M. ASCE

Professor and Head, Department of Civil Engineering, Mississippi State College, State College, Miss.

The add-area method, which has been used to good advantage for about twenty-five years for the design of steel columns with bending, can be extended to include composite sections. The design of concrete columns supporting eccentric loads is usually quite a long process unless graphs are available. No doubt the best general solution would be a complete set of curves with P/A_g plotted against p for all values of e/t, making the selection of sections a direct process. Such a set of curves would require an enormous amount of work. In the absence of these curves the following approximate method has been found extremely helpful.

The notation used is as follows:

- A_s = total steel area in section
- A_b = tension steel required for balanced beam
- A_s' = area of compression steel in unsymmetrical section
- b = total width of section required by combined loading
- b_c = width of section required by axial load
- b_b = width of section required by bending
- c = distance from gravity axis to compression surface
- f = unit stress, general case
- f_c = allowable unit compressive stress in an axially loaded column
- f_b = allowable unit compressive stress in a beam
- P/A_g = axial load divided by geometric area of the section
- $R_s = \frac{M}{b\,t^2}$ = strength factor for a beam with symmetrical reinforcing
- $R_a = \frac{M}{b\,d^2}$ = strength factor for a balanced beam, with no compression steel

For the dimensional notation see Fig. 1.

Consider first a homogeneous section. Since the allowable unit stress for columns is different from that for beams, a solution of the equation,

$$f = \frac{P}{A} + \frac{Pec}{I} \quad . \quad . \quad . \quad . \quad (1)$$

is meaningless unless the allowable unit stress for combined loading is known. However, if Eq. 1 is rearranged to read

$$A = \frac{P}{f_c} + \frac{Pec}{f_b r^2} \quad . \quad . \quad . \quad . \quad (2)$$

a section can be selected—usually by one trial—which will satisfy the conditions. In this equation, f_c is the allowable unit compressive stress in an axially loaded column, and f_b is the allowable unit stress in a beam. Eq. 2 is in the proper form for the selection of sections whose properties are available in handbooks.

For rectangular sections whose dimensions are determined by the designer, the add-area formula should be changed to read

$$b = \frac{P}{f_c\,t} + \frac{6Pe}{f_b\,t^2} \quad . \quad . \quad . \quad . \quad (3)$$

Here, instead of adding areas we are adding widths.

The problem in the design of reinforced concrete columns is quite different because the concrete does not resist tensile forces. A pictorial representation of the add-area section for concrete columns which are symmetrically reinforced is shown in Fig. 1(*a*). In this sketch, b_c is the width required by the axial load, and b_b is the width required by bending moment. Now obviously a section cannot crack as shown in Fig. 1.

FIG. 1. Add-area sections for concrete columns with symmetrical and unsymmetrical reinforcing (below left and right).

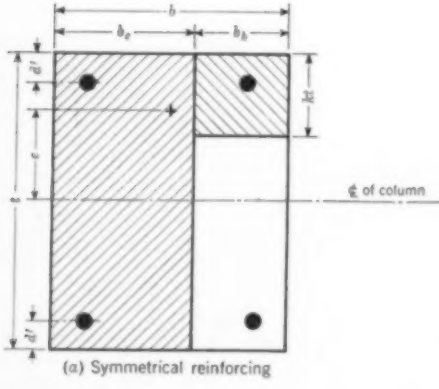
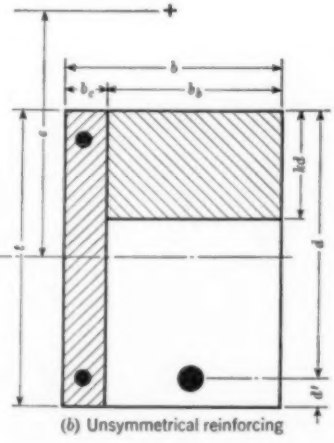
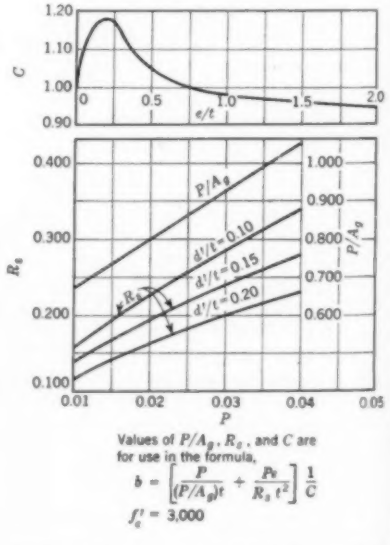


FIG. 2. Design formula for tied column in bending and direct stress, with symmetrical reinforcing (far right).





Nevertheless, the add-area method, with the formula in the form,

$$b = \frac{P}{(P/A_g)t} + \frac{Pe}{R_s t^2} \quad . \quad . \quad (4)$$

can be used to design eccentrically loaded concrete columns, if it is modified by a correction factor to compensate for the fact that the mathematics does not exactly represent the physical conditions. In Eq. 4,

$$(P/A_g) = 0.18 f_c' + f_s p$$

and

$$R_s = \frac{M}{b t^2}$$

In describing this method, the word "error" will be used to mean simply the difference between two values obtained by two methods, one of which is more approximate than the other—not the difference between a correct value and an approximate value.

The error caused by the use of Eq. 4 can be determined by comparing the results of its use with those obtained by "recognized theory." All the variables involved in the design of the section influence the correction curve, but it always has the same shape; and one curve for each value of f_c' is sufficient to reduce the error to a maximum of about 10 percent. (For uncommonly large or small values of d/t the error might be as high as 15 percent.) The design formula, with the correction included, together with the curves required, is shown in Fig. 2.

Values of R_s plotted in Fig. 2 are based on the assumption that compression in the concrete is the critical stress. But when e/t reaches amounts varying from 1.5 to 2.0, tension in the steel may determine the strength of the section. Furthermore, for large eccentricities, symmetrical reinforcing is not too economical. No doubt there is a most economical ratio of compression steel to tension steel for any imaginable condition, but the designer could hardly afford to determine it unless a member were to be repeated many times.

Comparative designs have shown that columns with large eccentricities, or beams with light axial loads, can be designed by the add-area method, simply by changing Eq. 4 to read

$$b = \frac{P}{(P/A_g)t} + \frac{Pe}{R_o d^2} \quad . \quad . \quad (5)$$

In Eq. 5, $R_o = \frac{M}{b d^2}$, the strength factor for a beam with no compressive reinforcement. The add-area section from which this equation is derived is shown in Fig. 1(*b*).

Examples Illustrate Procedure

Two examples will be given for symmetrical reinforcing and one for unsymmetrical.

Example 1 (symmetrical reinforcing). Given: $P = 120^k$, $e = 2$ in., $f_c' = 3{,}000$ psi, $d' = 2^1/_2$ in.

Let $p = 0.025$ and try $t = 14$ in., $d'/t = 0.18$, and $e/t = 0.14$. Values of R_s, P/A_g, and C are obtained from Fig. 2. Then

$$b = \left(\frac{120}{0.858 \times 14} + \frac{240}{0.192 \times 14^2}\right)\frac{1}{1.17}$$
$$= (10.0 + 6.4)\,\frac{1}{1.17}$$
$$= 13.8 \text{ in.}$$
$$A_s = 4.8 \text{ sq in.}$$

Example 2 (symmetrical reinforcing) Given: $P = 120^k$, $e = 20$ in., $f_c' = 3{,}000$ psi, $d' = 2^1/_2$ in.

Let $p = 0.04$ and try $t = 22$ in., $d'/t = 0.11$, $e/t = 0.91$. Then

$$b = \left(\frac{120}{1.050 \times 22} + \frac{2{,}400}{0.328 \times 22^2}\right)\frac{1}{0.98}$$
$$= (5.2 + 15.1)\,\frac{1}{0.98}$$
$$= 20.7 \text{ in.}$$
$$A_s = 18.2 \text{ sq in.}$$

Example 3 (unsymmetrical reinforcing, Eq. 5 with correction). Given: $P = 70^k$, $e = 40$ in., $f_c' = 3{,}000$ psi, $d' = 2^1/_2$ in. Let $P_c = 0.04$. For 3,000-lb concrete, $P_b = 0.0136$ and $R_o = 236$. Try $t = 26$ in., $d'/t = 0.10$, $e/t = 1.54$. Then

$$b = \left(\frac{70}{1.050 \times 26} + \frac{2{,}800}{0.236 \times 23.5^2}\right)\frac{1}{0.96}$$
$$= (2.6 + 21.4)\,\frac{1}{0.96}$$
$$= 25 \text{ in.}$$
$$A_s' = {}^1/_2(3.6 \times 26 \times 0.04) = 1.9 \text{ sq in.}$$
(all the correction on b_c)
$$A_b = 0.0136 \times 21.4 \times 26 = 7.6 \text{ sq in.}$$
$$A_t = 9.5 \text{ sq in.}$$
$$A_s = 11.4 \text{ sq in.}$$

Apropos of the question of degree of accuracy, it is worthwhile to note that in Example 3, when e/t is 1.54, the width required by the axial load is only about 11 percent of the total width. Hence the error cannot be large for this value of e/t or for any greater value.

Perhaps it should be stated that the sketches of Fig. 1 are for design concepts only, and that the columns are constructed with the steel placed symmetrical about the axis in the plane of the bending.

Shortcut calculating-machine method computes P.I. of two lines

WM. F. WARFIELD, A.M. ASCE

Licensed State Land Surveyor, Houston, Tex.

The problem of closing a traverse through two known points and an unknown third point can be solved in various ways. When solving for the point of intersection of two lines, a decided advantage over the conventional sine-law method, as well as the method of two simultaneous equations, can be secured by using a calculating machine. The method here described is a simplified version of that presented by Henry G. Weissenstein in CIVIL ENGINEERING for September 1947 (p. 43). The new method eliminates the use of negative coordinates, thus saving considerable time and reducing chances of error. In addition, the use of all positive coordinates conforms more closely to usual engineering practice, reduces the number of terms involved, and minimizes the use of algebraic signs.

The traverse need not be in a coordinated system nor have coordinates established for all points. In any traverse that is not coordinated, the only positive coordinate values needed are those for the two points that the intersecting lines are to originate from, or be passed through. Convenient positive coordinates for these two points can readily be determined as follows:

1. The sums of the latitudes and the departures in the unclosed traverse are noted.

2. Any convenient constant, pref-

erably some even thousand, that is greater than the absolute value of any of the four sums is selected.

3. With due regard to signs, the difference of the northings and southings is then algebraically added to the selected constant for the North coordinate of the second or end point in the unclosed traverse.

4. Likewise, the difference of the eastings and westings is algebraically added to the constant for the East coordinate of the same point.

5. The constant itself is then equal to both the North and the East coordinate of the first or beginning point in the traverse.

The following example is the same as Mr. Weissenstein's except that positive coordinates have been substituted for negative ones. In a coordinated grid system, minus coordinates can be converted to positive values simply by moving the point of origin south and west sufficient distances. On the standard traverse form normally used in calculating land surveys, the given data are conveniently entered, as shown in Fig. 1.

Example Worked Out

In the bearing column, enter the given bearings of the two lines to be intersected. On the same line on the form, in the coordinate columns, enter the coordinates of the point each respective bearing originates from, or is to be passed through. At any convenient place on the same line, write in the tangent of each bearing, as shown in Fig. 1, giving these functions their respective algebraic sign according to the quadrant, that is, northeast plus, southeast minus, southwest plus, and northwest minus. The line with the tangent of the largest absolute value is designated as No. 1, the other as No. 2. On the third line on the form, record the algebraic difference of the two tangents. The position of the counter-reverse lever (the small lever near the upper right-hand corner of any standard calculator keyboard) depends on the sign of the tangent of largest absolute value (line No. 1). If this sign is plus, the counter-reverse lever must be in the "up" position, which it normally is in for positive calculating operations. If the sign is minus, the counter-reverse lever must be in the opposite position for negative operations.

On any standard calculating machine, the operational steps are as follows:

Step 1. Set the decimal points on the machine. The number of decimal places in the upper dials of the carriage (multiplier dials) should be one or more places greater than the number of decimal places in the desired results. The number of decimals on the keyboard must be equal to or greater than the decimals of the trigonometric functions used (five-place functions are accurate enough for all practical purposes). The number of decimals in the lower dials of the carriage (product dials) must be equal to the sum of the two. (On a ten-bank machine, 5 decimals in the upper dials, 5 on the keyboard, and 10 in the lower dials, are very satisfactory). The counter-reverse lever is set at the position indicated by the sign of the tangent of largest absolute value. Neither the counter-reverse lever nor the decimal points will be changed during the calculations.

Step 2. The figures in the line designated as No. 1 are set on the machine in the following order:

East coordinate on lower dials
North coordinate on upper dials
Tangent of bearing on keyboard

Step 3. Without clearing anything, change the upper dials to the North coordinate in line No. 2.

Step 4. Clear the keyboard and set the difference of the tangents (third line) on the keyboard.

Step 5. By appropriate positive and negative multiplication, change the figures in the lower dials to the East coordinate in line No. 2. From the upper dials, record on the fourth line in the proper coordinate column the North coordinate, with all decimals, of the point of intersection.

Step 6. Without clearing, change the upper dials back to the North coordinate in line No. 2.

Step 7. Clear the keyboard only and set the tangent of the bearing in line No. 1 again on the keyboard.

Step 8. Change the upper dials to the North coordinate, with all decimals, of the point of intersection (fourth line). From the lower dials record the East coordinate of the point of intersection on the fourth line.

This completes the calculations for the coordinates of the point of intersection of two lines. With the latitudes and departures resolved from the coordinate differences, a check of the computations can readily be obtained. The tangents or cotangents are computed and the results compared with the correct trigonometric functions of the given bearings. In this example, the calculated tangent of line No. 2 exactly checks the given bearing. The calculated cotangent of line No. 1 checks the given bearing within 2 seconds.

Method Evaluated

Using the sines and cosines of the given bearings to compute the distances of the two lines, the only discrepancy noted is that the computed length of line No. 1 differs from Mr. Weissenstein's determination by 0.01 ft. In the December 1947 issue (p. 50), R. E. Burnett presented his solution of this same problem using the method of two simultaneous equations. The lengths of the lines as determined by Mr. Burnett are in agreement with the results obtained by the simplified method here presented.

SURVEY _____ CO. _____ CALCULATED BY _____ DATE _____ DIST

COSINE	SINE	BEARING	DISTANCE	LATITUDE		DEPARTURE		CO-ORDINATES	
				NORTH	SOUTH	EAST	WEST	NORTH	EAST
		N17°26'36"W		tan = −0.31357		(2)		12,843.77	11,674.96
		N80°33'12"E		tan = +6.01013		(1)		13,526.42	8,207.77
				+6.32370					
		(Pt. of Intersection)						14,040.65482	11,299.59

FIG. 1. Example shows data as entered for computing coordinates by calculating-machine shortcut method.

THE READERS WRITE

Rotogarage Doubles as A-Bomb Shelter

TO THE EDITOR: The members of our staff read the articles on the shelter problem, by James T. Martin and A. S. Neiman of the Federal Civil Defense Administration, in your June issue, with the greatest interest. Atomic bombing of our strategic cities is one of the most vital dangers facing us. The matter of providing effective air-raid shelter for the populations of their target areas may well be one on which the future security of our country will depend.

We feel that a distinction should be made between "shelter areas" as discussed in the articles, and A-bomb shelters per se. The desirable characteristics listed on page 33 cover the basic essentials for "shelter areas" in existing structures and are assumed to be comparatively safe at 2,500 ft from ground zero. But what of the target areas, that is, the areas, so-called, of total devastation? Are we to write off the populations of those areas as a total loss? Or is there a means of providing effective shelters for at least a part of those areas?

We believe that there is.

As we see it, any adequate shelter program for the target areas of our large cities *must* provide A-bomb shelters—not shelter areas alone—for such districts. To do so three basic elements must be considered:

1. Financial feasibility
2. Maximum protection from blast, heat and nuclear radiation within the limits of such financial feasibility
3. Shelter accessibility

Financial feasibility calls for the use of dual-purpose shelters that will place no undue financial burdens on private enterprise, nor on the federal, state or city governments.

Maximum protection, as indicated above, can only be had in structures of special types suitable for commercial use which pay their way in peacetime and yet are readily available for emergency use when circumstances require.

Shelter accessibility is automatically provided for when the first two conditions are met, as it is not financially feasible to provide the special types of structures required outside the target areas of our cities.

A structural unit should provide the basic elements for dual-purpose shelters efficiently, such as the Rotogarage, a huge parking machine for use on expensive sites in the congested business districts of our large cities (Fig. 1).

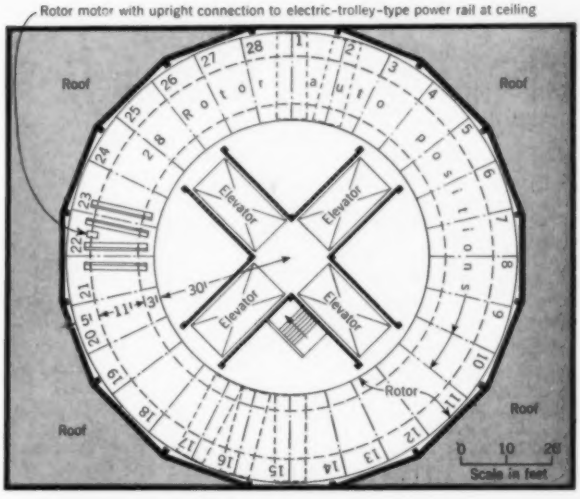


FIG. 1. Typical floor plan of Rotogarage which can double as A-bomb shelter.

The garage is a cylindrically shaped building set on a square (100 ft × 100 ft) foundation, with windowless walls of 8-in. reinforced concrete above the ground floor, braced at 9-ft intervals by its floors. It can be integrated as part of a parent building (in certain cases it may be installed into existing structures) serving as a series of floor-to-floor shelters; or, when erected as an individual unit, it can serve as a public shelter.

The basic Rotogaraging unit (12 stories, ground floor and basement) will shelter a minimum of 1,000 persons within eight minutes. This measure of effective A-bomb shelter is achieved without altering its basic design or interfering with its primary commercial use. When properly equipped, the structure has other important uses before, during and after an air raid: (1) as headquarters for Civil Defense personnel; (2) as a disaster control point; and (3) as a first-aid station or emergency hospital.

Because of its efficiency of operation, the Rotogarage can park and depark cars at a rate of 200 per hour at competitive parking rates. This is a matter of great importance. It has a direct bearing on the income potential for daytime parking (8 a.m. to 6 p.m.), the period of greatest earnings, because about 75 percent of the parking demand during that time is for 4 hours or less. It makes a financially feasible A-bomb shelter.

JOSEPH SALZMAN
Strobel and Salzman
Consulting Engineers
New York, N.Y.

Sabotage Destroyed Ceylon Irrigation Works

To the Editor: Mr. H. de S. Manamperi is in distinguished company when he suggests that the breakdown of the ancient irrigation works of Ceylon was in no way due to the inefficiency of the early Singhalese engineers (CIVIL ENGINEERING, January 1952, p. 137). Prof. A. J. Toynbee, in *A Study of History*, instances this ancient irrigation development as evidence for his thesis that civilizations may emerge in response to adverse natural conditions (p. 81). His explanation for the abandonment of the system (p. 257) is as follows.

"The works were deliberately sabotaged by invaders as a short cut to their military objectives; and a war-worn people had not the heart to go on repairing a damage that had been inflicted on them so many times and seemed certain to be inflicted again."

The page references are to D. C. Somervell's abridgment of Toynbee's work, published by Oxford University Press, 1948.

JOHN R. PHILIP, J. M. ASCE
Research Officer
C.S.I.R.O. Regional Laboratory
Deniliquin, N. S. W.
Australia

CENTENNIAL CONVOCATION

SYMPOSIUMS OF GENERAL INTEREST

CHICAGO, SEPTEMBER 3–13, 1952

Schedule of Symposium Programs

Symposium	Location	Dates Sept.
Professional Societies	8th St. Theater	3
Education and Training	8th St. Theater	4
Food	Palmer House, Red Lacquer Room	5
Tools	8th St. Theater	5
Transportation	Conrad Hilton Ballroom	8, 9
Mineral Industries	Sherman Ballroom	8, 9
Structures and Construction	8th St. Theater	8
Chemical Industries	8th St. Theater	9
Communications	8th St. Theater	11, 12
Energy	Conrad Hilton Ballroom	11, 12
Health	La Salle Ballroom	11
Urbanization	La Salle Ballroom	12

SECTION I. The Role of the Organized Profession

Wednesday, September 3, 9:30 A.M. and 2:00 P.M.
Eighth Street Theater
Chairman—Harry S. Rogers, M. ASCE, President, Polytechnic Institute of Brooklyn

Morning Session—9:30 A.M.

1. BACKGROUND AND DEVELOPMENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS
   James K. Finch, M. ASCE, Dean Emeritus, School of Engineering, Columbia University
2. PART PLAYED BY MILITARY ENGINEERS
   Elvin R. Heiberg, U.S. Military Academy, West Point, N.Y.
3. GROWTH OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
   A. B. Parsons, Consulting Engineer, Oakland, Calif.

Afternoon Session—2:00 P.M.

4. ADVANCEMENTS MADE BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
   George A. Stetson, Editor, *Mechanical Engineering*, New York, N.Y.
5. EVOLUTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
   M. B. Hooven, Electrical Engineer, Public Service Electric and Gas Co., Newark, N.J.
6. THE STORY OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS
   Sidney D. Kirkpatrick, Editorial Director, *Chemical Engineering—Chemical Week*, New York, N.Y.
7. THE INTER-SOCIETY ROLE
   Harry S. Rogers, M. ASCE, President, Polytechnic Institute of Brooklyn

SECTION II—Education and Training

Thursday, September 4, 9:00 A.M. and 1:30 P.M.
Eighth Street Theater
Chairman—A. A. Potter, Dean of Engineering, Purdue University

Morning Session—9:00 A.M.

1. **HISTORY OF ENGINEERING EDUCATION**

Frederic T. Mavis, M. ASCE, Head, Department of Civil Engineering, Carnegie Institute of Technology

A review of the evolution of engineering education from West Point and Rensselaer to the present, with reference particularly to its influence on the industrial and economic development of the country.

Discussion:

Blake R. Van Leer, President, Georgia Institute of Technology.
M. M. Boring, Manager, Technical Personnel Division, General Electric Co
Roy M. Green, M. ASCE, Dean, College of Engineering, University of Nebraska.
D. S. Bridgman, Staff Assistant in Personnel Relations, American Telephone and Telegraph Co.

2. **ACHIEVEMENT TO DATE IN ENGINEERING EDUCATION**

Thorndike Saville, M. ASCE, Dean, College of Engineering, New York University

The developments of the past century in engineering curricula, faculty, and research as affected by changing concepts of the place of the graduate engineer in the national economy and welfare, and by advances in sciences. The influences of the engineering societies (particularly ECPD and ASEE) on these developments. The trends for the future.

Discussion:

A. C. Monteith, Vice-President, Engineering Department, Westinghouse Electric Corp.
J. T. Rettaliata, President, Illinois Institute of Technology.
Ovid W. Eshbach, Dean, Northwestern Technological Institute.
Ralph L. Goetzenberger, Vice-President, Minneapolis-Honeywell Regulator Co.

Afternoon Session—1:30 P.M.

3. **THE TECHNICAL INSTITUTE: ITS RELATION TO ENGINEERING EDUCATION AND TO TRADE TRAINING**

C. W. Beese, Dean, Division of Technical Extension, Purdue University

An evaluation, in terms of the resulting impact on engineering and industry, of the technical institute type of training as a medium for increasing and improving the educational resources of subprofessional personnel.

Discussion:

C. L. Schwyhart, Manager, Department of Education and Training, Caterpillar Tractor Co.
L. J. Fletcher, Vice-President, Caterpillar Tractor Co.
Orvis Keller, Assistant to President in Charge of Extension, Pennsylvania State College.

4. **THE ENGINEER AND THE SCIENTIST**

W. F. G. Swann, Director, Bartol Research Foundation of Franklin Institute, Swarthmore, Pa.

The address will discuss the differences between problems presented in engineering practice and problems presented in the pure research laboratory. The differences are in different modes of attack and encourage different plans of thinking.

Discussion:

C. C. Furnas, Director, Cornell Aeronautical Laboratory, Inc.
J. E. Hobson, Director, Stanford Research Institute, Stanford University.

5. **LOOKING AHEAD FOR ENGINEERING EDUCATION**

S. C. Hollister, M. ASCE, Dean of Engineering, Cornell University

An evaluation of the developments in science and engineering that will affect in major ways the extension and expansion of engineering; and the suggestion of modifications in engineering programs to meet these situations.

L. M. K. Boelter, Chairman, Department of Engineering, University of California

Although the role of the prophet is precarious, an extrapolation will be hazarded, based upon the expansion of knowledge in the physical sciences, and the life sciences, supported by a study of the engineering profession and engineering education of today. A guideline is established by the extent to which the prognostications of engineering education of the last generation have been realized. Again, early engineering education will be examined to discover whether old ideas can be resuscitated and utilized.

Discussion:

H. L. Hazen, Head, Department of Electrical Engineering, Massachusetts Institute of Technology.
O. E. Buckley, President, Bell Telephone Laboratories.
F. C. Lindvall, Chairman, Division of Engineering, California Institute of Technology.
W. L. Everitt, Dean, College of Engineering, University of Illinois.

SECTION III. Food

Friday, September 5, 9:00 A.M. and 2:00 P.M.
Palmer House Ballroom
Chairman—Clarence Francis, Chairman of Board, General Foods Corp., New York, N. Y.

Morning Session—9:00 A.M.

1. **FOOD—NO. 1 WORLD PROBLEM**

Clarence Francis, Chairman of the Board, General Foods Corp., New York, N.Y.

The production of food is the greatest industry in the world, but it still falls short of anything like sufficiency for the world's billions of people. The challenge to science and engineering—and to all humanity—is not only to keep pace with the relentless demands of a growing population but to find new ways to increase the amounts of nutritious food available for every human being.

2. BALANCED USE OF THE LAND
Fairfield Osborn, President, Conservation Foundation, New York, N.Y.

3. ROLE OF THE FARMER
Wheeler McMillen, Editor, *Farm Journal*, Philadelphia, Pa.

Tools and power have had a tremendous impact on agricultural progress. If they are universally used, food production no longer will be a struggle, but will be a part of the production of a universally higher standard of living. Freedom has provided the incentive which has brought these favorable results.

4. TECHNOLOGICAL DEVELOPMENT OF FARMING
John L. McCaffrey, President, International Harvester Co., Chicago, Ill.

Afternoon Session—2:00 P.M.

5. TECHNOLOGY OF PROCESSING
John Holmes, President, Swift & Company, Chicago, Ill.

6. DISTRIBUTION OF THE PRODUCTS OF FARMING
Ned Fleming, President, Fleming Company, Inc., Topeka, Kans.

7. NUTRITION FOR HUMANS AND ANIMALS
Charles G. King, President, The Nutrition Foundation, Inc., New York, N.Y.

The century's transition from simple farm labor to farm engineering has reached with startling rapidity into the dining rooms of the world. Mechanically and economically, the service thus rendered is essential to our social structure, but its future success is dependent upon more efficient integration with the sciences of biochemistry and medicine. The present birth of a new profession, biochemical engineering, marks the beginning of a new age in agriculture, in public health and the enjoyment of living.

SECTION IV—Tools

Thursday, September 5, 9:30 A.M. and 2:30 P.M.
Eighth Street Theater
Chairman—Kenneth H. Condit, Dean, School of Engineering, Princeton University
Vice-Chairman—H. L. Tigges, Executive Vice-President, Baker Brothers, Inc., Toledo, Ohio

Morning Session—9:30 A.M.

1. HISTORICAL BACKGROUND
Kenneth H. Condit, Dean, School of Engineering, Princeton University

Man, the tool-using animal. The acceleration of his progress in the art and science of tool making and using in the past century.

2. SMALL TOOLS
Carl J. Oxford, Chief Engineer, National Twist Drill & Tool Co., Detroit (Rochester), Mich.

Development of the tools for the cutting of metals and other materials used in the manufacturing industries.

3. MACHINE TOOLS
Swan E. Bergstrom, Vice-President, National Machine Tool Builders Association, and Vice-President, Cincinnati Milling Machine Co., Cincinnati, Ohio

The devices that multiply the productive capacity of the individual by putting behind the cutting tool the resources of power and control of a century of development.

Afternoon Session—2:30 P.M.

4. MEASURING INSTRUMENTS AND TOOLS
Louis Polk, President, The Sheffield Corp., Dayton, Ohio

Without today's high standards of accuracy in measurement, and the instruments we have invented to attain these standards, modern mass production achievements would have been impossible.

5. TOOL ENGINEERING
Leslie B. Bellamy, President, American Society of Tool Engineers, Detroit, Mich.

A division of engineering in industry marked by the technique of planning and equipping the processes required for manufacturing, and participating in the refinement of the product design to facilitate manufacturing.

6. THE NEXT CENTURY
The Hon. Ralph E. Flanders, United States Senator from Vermont

Are we nearing the end of an era of progress, is our rate of acceleration diminishing, or are we on the threshold of new and undreamed-of engineering accomplishment?

SECTION V. Transportation

Monday and Tuesday, September 8 and 9
Conrad Hilton Ballroom
Chairman—Charles F. Kettering, Hon. M. ASCE, Research Consultant, General Motors Corp., Detroit, Mich.

1. AUTOMOBILES
Christy Borth, Automobile Manufacturers Assoc., Detroit, Mich.

2. SHIPS
Admiral Harold G. Bowen, Executive Director, Thomas Alva Edison Foundation, Inc., West Orange, N.J.

3. TRAILERS
V. M. Drew, Director of Research, Fruehauf Trailer Co.

4. AIRCRAFT
O. T. Kreusser, Allison Division of General Motors, Indianapolis, Ind.

5. THE GROWTH AND STATUS OF HIGHWAY TRANSPORT
B. B. Bachman, Vice-President, Autocar Company, Ardmore, Pa.

A description of the origin and development of the particular manner through which this form of transportation serves the economy.

6. RAILROADS
Fred G. Gurley, President, Atchison, Topeka and Santa Fe Railroad, Chicago, Ill.

7. BUSES
Leon F. Banigan, Editor, *Bus Transportation*, New York, N.Y.

8. FARM TRACTORS

9. AIR FRAME
C. S. (Casey) Jones, President, Academy of Aeronautics, LaGuardia Airport, New York, N.Y.

SECTION VI—Mineral Industries

Monday, September 8 and Tuesday, September 9
9:30 A.M. and 2:00 P.M.
Hotel Sherman Ballroom
Chairman—Clyde Williams, Director, Battelle Memorial Institute, Columbus, Ohio
Secretary—Richard J. Anderson, Assistant Supervisor, Battelle Memorial Institute, Columbus, Ohio

MONDAY, SEPTEMBER 8

Morning Session—9:30 A.M.

1. INTRODUCTION—Chairman

2. EXPLORATION FOR METALS, PETROLEUM AND WATER

   William E. Wrather, Director, United States Geological Survey, Washington, D. C.

   Dr. Wrather will trace the development of methods successfully used for finding minerals, oil, and water, showing the advantages and shortcomings of each method. He will explain how important discoveries have resulted from the various techniques used and how industries and national economies have benefited, and suggest what lies ahead in improved procedures.

3. MINING AND QUARRYING

   Donald H. McLaughlin, President, Homestake Mining Co., San Francisco, Calif.

   Although richly endowed with natural resources, the continental United States could never have reached its present position of world prominence but for the efficiency and productiveness of its mines. Into the mining industry has been thrown the collective ingenuity of many types of engineering, with the result that here this ancient activity has reached new levels of mechanization—fantastically powerful machines for moving rock, new types of drills, conveyors, hoists, explosives, locomotives, lamps, and safety devices. The art of moving great quantities of earth, spearheaded by the use of the "bulldozer," has been carried by Americans, both in war and peace, to the remote corners of the world, aiding others to make use of their natural resources to a degree never thought humanly possible, let alone economically feasible.

Afternoon Session—2:00 P.M.

4. COAL—MINING, PREPARATION, AND UTILIZATION

   J. B. Morrow, Consulting Mining Engineer, Alford, Morrow and Associates, Pittsburgh, Pa.

   The magnitude and the strength of the American industrial economy is based on its utilization of the available energy resources. It is no longer chance that the American coal mine is more productive than any coal mine in the world. The development of drilling machines, safe blasting powders, loading machines, locomotives, conveyors, and most recently the mining machine, has raised the productivity of the American coal miner well above his European counterpart. The coal industry looks forward to the day when coal will play an even more important part as an industrial raw material, and it is confident that engineering and research will make this technically feasible and economically possible.

5. ORE BENEFICIATION AND HYDROMETALLURGY

   O. C. Ralston, Chief Metallurgist, U. S. Bureau of Mines, Washington, D.C.

   The past one hundred years have seen the richest deposits of metal ores in the United States either exhausted or severely depleted. As we turn to more complex and to lower- and still lower-grade deposits, the science and engineering of ore treatment represent not only one of the world's outstanding technical accomplishments, but also a vital contribution to world economy by bringing to the consumer a continuing supply of needed materials in the face of a continually diminishing reserve.

   We can look forward to the future with renewed confidence, as new developments in ore beneficiation and hydrometallurgy are advanced to meet the demands of an increasingly complex and rapidly growing industrial economy.

6. NONMETALLIC MATERIALS

   John D. Sullivan, Assistant Director, Battelle Memorial Institute, Columbus, Ohio

TUESDAY, SEPTEMBER 9

Morning Session—9:30 A.M.

7. IRON AND STEEL PRODUCTION AND THE COKE INDUSTRY

   Walther Mathesius, Consultant, Freyn Engineering Division, Koppers Co., Inc., Chicago, Ill.

   Steel production is a true measure of a nation's industrial strength. Faced with rising costs of raw materials on one hand, and with increasing competition from nonferrous metals and from nonmetallic materials on the other, the steel industry has sought improvement in efficiency, and has pushed mechanization and labor-saving devices. Through its fuel requirement, the steel industry has sponsored the coke industry, by-products from which are now a primary source of raw materials for the chemical plants of the nation. As the iron-ore supply picture changes, and as the types and uses for steel become more varied and complex, the steel industry will have to adjust itself to this environment.

8. NONFERROUS SMELTING AND REFINING

   R. W. Diamond, President, Consolidated Mining and Smelting Co. of Canada, Ltd., Trail, British Columbia

   Among the nonferrous metals are materials of great antiquity, while others are comparative newcomers to our economy. The past one hundred years has seen one metal after another leave the category of "rare metals" to join the growing family of nonferrous metals that are available in good supply. Improvements in smelting methods have made it possible to segregate valuable by-products, that were formerly lost in slags or flue gases. The trend toward greater efficiency—toward the discovery of new processes—will continue. Titanium and zirconium may soon join the less abundant, but current cheaper metals, in helping to shape the economy of the future.

Afternoon Session—2:00 P.M.

9. SYNERGISM OF ENGINEERING AND PETROLEUM

   Robert E. Wilson, Chairman of the Board, Standard Oil Co. (Indiana), Chicago, Ill.

   To describe the role of the petroleum industry in the development of our economy is to relate the history of the

reciprocating, spark-ignited engine and its contribution to our civilization. The petroleum industry has made possible the automobile, and, in turn, petroleum production has been encouraged, by the demand for fuel and lubricants, to become a giant industry. Engineering is tightly interwoven with production of petroleum, with manufacture of petroleum products, and with the design and manufacture of those machines that provide the market for petroleum products. The successful interdependence of the petroleum industry and the machine has been possible only through engineering.

10. **THE ROLE OF METALS IN OUR ECONOMY**

Zay Jeffries, Vice-President, General Electric Co., Pittsfield, Mass.

Metals whose existence in the pure state were unknown or so scarce as to be considered rare in 1852 are now commonplace. The ancient metals of early civilizations—iron, copper, tin and lead, and even gold and silver—are employed for purposes which early metal workers never imagined. Tremendous strides in the science of metallurgy have led to a better understanding of how metals behave under widely variable conditions, have made possible the development of metal structures light enough to fly, or strong enough to support a mighty bridge. Even the atomic bomb materials are metals. We live in a "metal age," an environment in which new metal requirements, new metallic products, and new uses for metal follow one another in a bewildering parade. We begin the next century with an accelerating tempo.

11. **COMMENTARY—Clyde Williams, Chairman**

SECTION VII—Structures and Construction

Monday, September 8, 9:30 A.M. and 2:00 P.M.
Eighth Street Theater
Chairman—Waldo G. Bowman, M. ASCE, Editor, *Engineering News-Record*, New York, N. Y.

Morning Session—9:30 A.M.

1. **WHAT CONSTRUCTION MEANS TO AMERICA**

Willard Chevalier, M. ASCE, Executive Vice-President, McGraw-Hill Publishing Co., New York, N. Y.

The inspiring story of how the U. S. standard of living has moved upward on steps fashioned by construction, of the essentiality of construction to the maintenance of an expanding economy, and of the continued need for economic freedom and incentive in advancing the engineering arts and the construction processes.

2. **HOW MAN HAS DEVELOPED BUILDINGS TO SERVE HIS EVERY NEED**

John O. Merrill, Skidmore, Owings & Merrill, Architects, New York, N.Y.

An account of the problems and the triumphs in moving from the pioneer cabin to the modern home, from the trading post to the towering skyscraper, and from the blacksmith shop to the broad-spread factory—and a prophecy of what the future promises.

3. **HOW DAMS HAVE BECOME MAN'S VITAL SERVANT FOR FOOD, WATER POWER AND PROTECTION FROM FLOODS**

Gail A. Hathaway, M. ASCE, Special Assistant to Chief of Engineers, U. S. Army, and former U. S. Chairman, International Commission on Large Dams, Washington, D.C.

A review and forecast of the contributions that engineers have made to better living by impounding the waters of our rivers, of the tribulations and the successes in designing and constructing dams of ever larger size or of more efficient type to fit increasingly difficult sites and to serve multipurpose needs.

4. **HOW BRIDGES HAVE INCREASED MAN'S MOBILITY**

David B. Steinman, M. ASCE, Consulting Engineer, New York, N.Y.

The epic of America's transformation by transportation routes made continuous by the bridge engineer's successful conquest of increasingly difficult obstacles, of world-famous and record-breaking spans across which cities expanded and a nation was knit together, of abilities to surpass the past with bridges of longer span, higher efficiency and greater beauty.

Afternoon Session—2:00 P.M.

5. **HOW SCIENCE WAS APPLIED TO DESIGN, INCREASING MAN'S CONTROL OVER SAFETY AND ECONOMY**

Linton E. Grinter, M. ASCE, Dean, Graduate School and Director of Research, University of Florida

An appraisal of the growth in knowledge of forces and their control that changed design from an art to a science, that supplemented and refined it by analysis and that, in consequence, permitted the engineers of this century to create thousands of astonishing structures, whereas each great masterpiece of the ancients required the efforts of an entire kingdom for a generation or two.

6. **HOW NEW MATERIALS INCREASED MAN'S BUILDING ABILITY**

Walter C. Voss, A. M. ASCE, Head, Department of Building, Engineering and Construction, Massachusetts Institute of Technology

An evaluation of the application of modern knowledge of metallurgy and chemistry, aided by powered manufacturing methods, to give us a Pandora's box of materials offering a wide choice in such qualities as strength, heat resistance, weight, transparency, flexibility, shape, texture and even color.

7. **HOW MECHANIZATION BROUGHT SPEED AND ECONOMY TO CONSTRUCTION AND CREATED A GREAT INDUSTRY**

Harold W. Richardson, M. ASCE, Editor, *Construction Methods and Equipment*, New York, N.Y.

A vivid portrayal of the emancipation of the building processes from manual labor, of the development of machines to multiply output and increase the size and variety of structures, and of the new type of thinking that gives American construction a dynamic quality that fits it to cope confidently with any challenge that the future may bring.

SECTION VIII—Chemical Industries

Tuesday, September 9, 9:00 A.M. and 2:00 P.M.
Eighth Street Theater
Chairman—Francis J. Curtis, Vice-President, Monsanto Chemical Company

Morning Session—9:00 A.M.

1. INTRODUCTION—Chairman

2. DEFINITION—IMPORTANCE OF CHEMICAL INDUSTRIES

   Sidney D. Kirkpatrick, Editorial Director, *Chemical Engineering—Chemical Week*

   The term "chemical industries" can obviously be an elastic one. It is, therefore, desirable in the beginning of the discussion to define what we mean by "chemical industries" and give a survey of their size and importance.

3. CHEMICAL ENGINEERING—A NEW SCIENCE

   Warren K. Lewis, Professor of Chemical Engineering, Massachusetts Institute of Technology

   Compared to the other branches of engineering, chemical engineering is relatively new. Dr. Lewis will discuss this science from the standpoint of one who has had a great deal to do with its formation.

4. INDUSTRIAL CHEMICALS—INORGANIC

   William T. Nichols, Vice-President, American Institute of Chemical Engineers

   Inorganic chemicals, usually manufactured on a large scale and at a low margin of profit, have depended for their success on taking advantage of engineering progress. The discussion will point out where these developments have been of the greatest importance.

5. INDUSTRIAL CHEMICALS—ORGANIC

   H. E. Thompson, Vice-President, Union Carbide & Carbon Corp., New York, N.Y.

   With the advent in recent years of the large scale of manufacture of organic chemicals, engineering has played more and more of a part. The chief developments which have brought this new industry into being in the last 25 years will be described.

Afternoon Session—2:00 P.M.

6. DRUGS AND MEDICINES

   Randolph T. Major, Vice-President, Merck & Company, Inc.

   The development of synthetic and biochemical methods of drug manufacture have brought in many problems of engineering and necessitated rapid advances in entirely new engineering techniques. The importance of these new techniques will be brought out.

7. PETROLEUM

   E. V. Murphree, President, Standard Oil Development Co.

   The petroleum industry was one of the earliest to adopt chemical engineering and has been one of the greatest factors in the development of that phase of engineering. What has been done and what remains to be done is of great importance to the chemical industries as a whole.

8. PLASTICS

   Frank C. McGrew, Assistant Research Director, E. I. du Pont de Nemours & Co., Inc.

   The plastics industry, tied up as it is with processes of polymerization, has had to develop many new engineering techniques to bring it to its present successful position. These techniques will be reviewed and predications made for the future.

9. FIBERS

   J. B. Quig, Manager, Textile Research Division, E. I. du Pont de Nemours & Co., Inc.

   Man-made fibers are playing an increasingly important part in our textile industry and supplementing and improving the historical natural fibers. In the development of synthetic fibers, engineering has played an extremely important part in solving difficult problems.

SECTION IX. Communications

Thursday and Friday, September 11 and 12
9:30 A.M. and 2:15 P.M.
Eighth Street Theater
Chairman—W. H. Harrison, President, International Telephone & Telegraph Co., New York, N. Y.
Vice-Chairman—L. A. DuBridge, President, California Institute of Technology

THURSDAY, SEPTEMBER 11

Morning Session—9:30 A.M.

1. TELEPHONY

   H. S. Dumas, Executive Vice-President, American Telephone & Telegraph Corp., New York, N.Y.

2. TELEGRAPHY

   H. P. Corwith, Vice-President in Charge of Development & Research, The Western Union Telegraph Co., New York, N.Y.

3. RADIO

   W. L. Everitt, Dean, College of Engineering, University of Illinois

Afternoon Session—2:15 P.M.

4. TELEVISION

   E. W. Engstrom, Vice-President, Radio Corporation of America, Princeton, N.J.

5. RADAR PAYS DIVIDENDS

   L. A. DuBridge, President, California Institute of Technology

FRIDAY, SEPTEMBER 12

Morning Session—9:30 A.M.

6. PRINTING

   John J. Deviny, Public Printer of the United States, Washington, D.C.

7. MOTION PICTURES

   Paul Raibourn, Vice-President, Paramount Pictures Corp., New York, N.Y.

8. ILLUMINATION

   Willard C. Brown, Manager of Application Engineering, General Electric Co., Cleveland, Ohio

Afternoon Session—2:15 P.M.

9. COMMUNICATION AND THE FUTURE
   J. W. McRae, Vice-President, Bell Telephone Laboratories, Inc., New York, N.Y.

10. LAY COMMENTARY

SECTION X—Energy

Thursday, September 11 and Friday, September 12
10:00 A.M. and 2:00 P.M.
Conrad Hilton Ballroom
Chairman—Eugene Ayres, Technical Assistant to Executive Vice-President, Gulf Research and Development Co.

THURSDAY, SEPTEMBER 11

Morning Session—10:00 A.M.

1. INTRODUCTION—Chairman

2. DEMANDS FOR ENERGY
   Richard J. Lund, Supervisor, Engineering Economics Division, Battelle Memorial Institute, Columbus, Ohio
   Discussion of trends in over-all use of energy in terms of total use, use per capita, and use per unit of gross national product; trends in total end uses, and trends by type of fuel; United States and world-wide aspect of energy demands; a glimpse at future demand trends.

3. COAL RESERVES—A MATTER OF ECONOMICS
   Harold J. Rose, Vice-President and Director of Research, Bituminous Coal Research, Inc.
   The coal reserves of the United States are far greater than those of all other mineral fuels combined. Potential reserves are so enormous that coal can supply the nation's energy and chemical requirements for many centuries to come. The total amount that will be produced, and the life of U. S. coal reserves will depend largely on future economics and technology.

Afternoon Session—2:00 P.M.

4. AVAILABILITY OF OIL PRODUCTS
   E. V. Murphree, President, Standard Oil Development Co.
   The problem for the future centers on the degree to which it will be necessary to import oil into the United States. The factors involved are existence, technology, and economics. Liquid fuels may eventually be produced from oil-shale, tar sands, coal, and even vegetation.

5. SUPPLY OF WATER POWER IN THE UNITED STATES
   F. M. Gunby, M. ASCE, Associate and a Director, Chas. T. Main, Inc., Boston, Mass.
   This paper shows the place now occupied by water power in the field of power for the U. S. and deals principally with the public utilities situation. It will embrace the probable potential or undeveloped water power by geographical areas. Factors affecting cost trends and improvements in technology now and in earlier days will be touched on.

FRIDAY, SEPTEMBER 12

Morning Session—10:00 A.M.

6. STEAM AND ELECTRIC POWER—ITS PAST AND FUTURE
   Theodore Baumeister, Stevens Professor of Mechanical Engineering, Columbia University
   The paper traces the impact of the steam power plant in its application to stationary services, both public utility and industrial, for the generation of electric energy. The historical phases of the subject are traced for the purpose not only of recording past accomplishments but for the more important reason of attempting to glimpse the future. The role of steam power in the industrial development of the nation is thus treated to facilitate an appreciation of the implications of what lies ahead for the power engineer.

7. DISTRICT STEAM HEATING
   By the following Past-Presidents of National District Heating Association: Ernest E. Dubry, Robert L. Fitzgerald, William A. Herr, Robert D. Martin, Leonard S. Phillips, J. Earl Seiter, Glen D. Winans; presented by A. R. Mumford, Research Department, Combustion Engineering-Superheater, Inc.
   The amount of energy required for space heating is reduced by district operations because the conversion units are larger, by-product operations are used, highly trained personnel are employed, and experts in utilization are available to the consumer. Centralized absorbers applicable to district operations could be larger and less of an architectural problem than isolated absorbers.

Afternoon Session—2:00 P.M.

8. WARMTH FOR COMFORT
   Maria Telkes, Research Associate, Massachusetts Institute of Technology
   The mental and physical performance of persons is correlated with their environmental comfort. Heating and cooling determine comfort, and its maintenance, by the most effective devices, is in turn a major problem of fuel and power engineering. Recent developments in radiant heating, electrical heating and solar heating in connection with heat storage, the use of "off-peak" power, and the heat pump are summarized.

9. CONSERVATION IN PRODUCTION OF OIL AND GAS
   William J. Murray, Jr., Commissioner, Railroad Commission of Texas
   State regulation of production is uniquely applicable to oil and gas. The body of regulations evolved during the past few decades has made it profitable for private companies to operate with minimum waste. The engineering principles of conservation practice are outlined with discussion of outstandingly successful results.

10. COMMENTARY
    Eugene Ayres, Technical Assistant to the Executive Vice-President, Gulf Research and Development Company

SECTION XI—Health and Human Engineering

Thursday, September 11, 9:00 A.M. and 2:00 P.M.
La Salle Hotel Ballroom
Chairman—Thomas Parran, Dean, Graduate School of Public Health, University of Pittsburgh

Vice-Chairman—Mark D. Hollis, M. ASCE, Assistant Surgeon General, Chief Sanitary Engineer Officer, U. S. Public Health Service, Washington, D. C.

Secretary—Theodore F. Hatch, Professor, Industrial Health Engineering, Graduate School of Public Health, University of Pittsburgh

Morning Session—9:00 A.M.

1. INTRODUCTION—Chairman

2. CONTRIBUTIONS OF ENGINEERING TO THE ADVANCEMENT OF HEALTH

   Abel Wolman, M. ASCE, Professor, Sanitary Engineering, Johns Hopkins University, School of Engineering

   Achievements during the past century

3. ROLE OF THE SANITARY ENGINEER IN PUBLIC HEALTH

   Mark D. Hollis, M. ASCE, Assistant Surgeon General, Chief Sanitary Engineer Officer, U. S. Public Health Service

   Difficulties between sanitary and other branches of engineering; combining many special non-engineering fields; new problems involving total environmental control, including radiological defense and air pollution.

4. PRESENT STATUS OF INSECT AND RODENT VECTOR CONTROL IN PUBLIC HEALTH

   John A. Logan, A. M. ASCE, Division of Medicine and Public Health, The Rockefeller Foundation, London, Eng.

   The Golden Era of insect control: yellow fever, malaria, typhus, new insecticides; future needs and possibilities.

Afternoon Session—2:00 P.M.

5. ENGINEERING CONTROL OF MAN'S PHYSIOLOGICAL ENVIRONMENT

   Craig L. Taylor, Professor of Engineering, Department of Engineering, University of California

   Human requirements for control of the thermal, illumination, acoustic and atmospheric environments. The impact of engineering systems upon man, considered from the points of view both of the stresses of the uncontrolled environment and of the engineering maintenance of optimal conditions which extend the sphere of homeostasis in man.

6. ENGINEERING CONSIDERATIONS IN THE MAN-MACHINE RELATIONSHIP

   Leonard C. Mead, Research Coordinator, Tufts College

   The machine is a means for extending and elaborating man's capacities. To insure maximum return for any man-machine combination, the design and operation of the machine must conform to the characteristics and limitations of human engineering. The paper aims to translate the laws governing human performance into proper terms for use in machine design.

7. THE CONTRIBUTION OF ENGINEERING TO OPTICAL HYGIENE AND VISION

   Samuel G. Hibben, Director of Applied Lighting, Westinghouse Electric Corporation, Bloomfield, N.J.

   Vastly increasing intrinsic brightnesses of illuminants have lead to highly ingenious reflecting materials and refracting devices for both the control of discomfort glare and the increase of foot-candle levels. New phosphors in modern illuminants increase efficiencies tenfold. Reduction of contrasts have helped television viewing. Developments in polarization greatly reduce the increased loading of the human seeing system, which has shown alarming tendencies to depreciate under today's visual strains.

8. COMMENTARY—Paul DeKruif, Author

Section XII. Urbanization

Friday, September 12
La Salle Ballroom
Chairman—Harland Bartholomew, M. ASCE, President, Harland Bartholomew & Associates, St. Louis, Mo.

1. THE CITIZEN'S VIEWPOINT—WHY PEOPLE MOVE OUT

   Richard Baumhoff, *St. Louis Post Dispatch*

   When a citizen is asked "Why have people moved to the suburbs?" his answer is apt to be that the cities are dirty, smoky, noisy—poorly planned for modern living and transportation, badly financed and poorly governed. These grave problems require solution. Where does the remedy lie? Do such organizations as the Port of New York Authority and the Bi-State Development Agency at St. Louis point the way? Is some sort of city-state political entity an answer?

2. THE VIEWPOINT OF THE PUBLIC ADMINISTRATOR—PROBLEMS CREATED FOR THE CITIES AND TOWNS

   L. P. Cookingham, City Manager, Kansas City, Mo.

   The past trend from rural and farm areas to metropolitan areas and the current movement away from cities to suburban areas have created a multitude of difficulties in government and everyday life. These encompass financial, legal, sanitary, public utility, law enforcement, health and other problems which need adequate solution. A City Manager makes recommendations for rectifying such perplexing matters.

3. PUBLIC OPINION—IMPORTANCE OF AN INTELLIGENT PUBLIC RELATIONS PROGRAM

   Fairfax M. Cone, Chairman of the Board, Foote, Cone & Belding

4. THE ENGINEER'S CONTRIBUTION TO THE DEVELOPMENT OF THE AMERICAN CITY

   Harold M. Lewis, M. ASCE, Consulting Engineer & City Planner, New York, N.Y.

   The tremendous growth of urban and suburban areas in America has been made possible only through engineering achievements in transportation, communications, sanitation, and steel-frame building construction. The civil engineer, as the first man on the ground in the survey of property lines and the layout of streets and utilities, has indelibly influenced the pattern of our cities. The municipal engineer, as these cities have grown in size and complexity, has been forced to assume increased responsibilities in problems of design, construction, economics, and finance. Modern city planning provides a growing opportunity for the civil engineer, in cooperation with men from other professions, to guide the future growth of urban development along efficient, practical, and esthetic lines.

CENTENNIAL CONVOCATION

ASCE CONVENTION

CELEBRATING A CENTURY OF ENGINEERED PROGRESS, 1852–1952

TECHNICAL AND SOCIAL PROGRAM

HEADQUARTERS: CONRAD HILTON HOTEL • CHICAGO, ILL. • SEPT. 3–13 1952

Papers marked with an asterisk (*) are published in Centennial (September) issue of *Civil Engineering*. Where papers are available in preprint form, preprint number follows title. Preprints and copies of Centennial issue of *Civil Engineering* are available at Headquarters Hotel.

REGISTRATION

CONRAD HILTON, Third Floor. Opens 9:00 a.m., Sept. 3, and each day 9:00 a.m. to 5:00 p.m., through Sept. 13.

LASALLE, Mezzanine. Opens 9:00 a.m., Sept. 3, and each day 9:00 a.m. to 5:00 p.m., through Sept. 5. Registration fee, except ladies and students, $3.00.

AUTHORS' BREAKFASTS

Briefing sessions for all speakers, discussers and program officials by invitation. Presiding: G. DONALD KENNEDY, Technical Program Chairman.

1. Wednesday, Sept. 3, 8:15 a.m., Parlor F., LaSalle Hotel, for participants in Wednesday Division sessions.

2. Thursday, Sept. 4, 8:15 a.m., same, for Thursday participants.

3. Friday, Sept. 5, 8:15 a.m., same, for Friday participants.

4. Monday, Sept. 8, 8:15 a.m., Boulevard Room, Conrad Hilton Hotel, for participants in Monday Division sessions.

5. Tuesday, Sept. 9, same, for Tuesday participants.

6. Thursday, Sept. 11, same, for Thursday participants.

7. Friday, Sept. 12, same, for Friday participants.

CONSTRUCTION LUNCHEON

Wednesday, September 3

12:30 P.M. GRAND BALLROOM, LA SALLE HOTEL

Sponsored jointly by Construction Division of ASCE and Associated General Contractors of America, Inc.

H. E. FOREMAN, Managing Director, Associated General Contractors of America, will address the luncheon. His subject will be "Development of the Construction Industry and the Contract Method in the United States."*

Presiding: A. H. Ayers, M. ASCE, Chairman of the Executive Committee, Construction Division, and Vice-President, Utah Construction Co., San Francisco, Calif.

All members, guests and friends of the two organizations are cordially invited to attend this significant event. Per plate, $3.50.

WEDNESDAY MORNING

SEPTEMBER 3

Construction–Highway Divisions, Joint Session

ILLINOIS ROOM, LA SALLE HOTEL

Presiding: DeWitt C. Greer, M. ASCE, State Highway Engineer, Texas State Highway Department, Austin, Tex.

9:30 American Highways—How to Measure Their Adequacy*

ROY E. JORGENSEN, M. ASCE;

Highway Engineer, National Highway Users' Conference, National Press Bldg., Washington, D.C.

10:15 **Improving the Load-Carrying Capacities of Subgrades**

CHARLES M. NOBLE, M. ASCE; Chief Engineer, New Jersey Turnpike Authority, New Brunswick, N.J.

11:00 **World's Best Highway System Produced by Modern Equipment***

A. N. CARTER, A.M. ASCE; Manager, Highway Division, Associated General Contractors of America, Inc., Washington, D.C.

WEDNESDAY AFTERNOON

SEPTEMBER 3

Construction Division—Associated General Contractors of America, Inc., Joint Session

ILLINOIS ROOM, LA SALLE HOTEL

Presiding: Kirby Smith, M. ASCE; Vice-President, Raymond Concrete Pile Co., New York, N.Y.

2:00 **Construction—A Growing Field for the Civil Engineer***

DWIGHT W. WINKELMAN, M. ASCE; President, D. W. Winkelman Co., Inc., Syracuse, N.Y.

2:45 **Labor Management Problems in the Construction Industry***

LESTER C. ROGERS, M. ASCE; President, Bates & Rogers Construction Corp., Chicago, Ill.

3:30 **Suretyship—A Stabilizing Factor in Construction Industry***

E. R. HIGGINS, J.M. ASCE; Engineer, The Surety Association of America, New York, N.Y.

TECHNICAL PROCEDURE CONFERENCE

Thursday, Sept. 4

Friday, Sept. 5

9:30 A.M. ROOM 19

CONRAD HILTON HOTEL

Invited representatives of the Technical Divisions will convene to discuss the expanding activities of the ASCE Divisions of special interest.

THURSDAY MORNING

SEPTEMBER 4

Construction Division

ILLINOIS ROOM, LA SALLE HOTEL

Presiding: A. H. Ayers, M. ASCE; Chairman, Executive Committee, Construction Division, Vice-President, Utah Construction Co., San Francisco, Calif.

9:30 **History of Development of Water Supply for City of Chicago (Preprint 68)**

W. W. DEBERARD, HON. M. ASCE; City Engineer, Department of Public Works, Chicago, Ill.

10:00 **Transportation by Pipeline**

B. E. HULL, retired, former President, Texas Pipeline Co., Dallas, Tex.

10:30 **The Construction Problems of Prestressing**

M. M. UPSON, M. ASCE; Chairman of the Board, Raymond Concrete Pile Co., New York, N.Y.

11:00 **Development of Civil Engineering Through the Ages**

C. J. MERDINGER, Civil Engineering Corps, U. S. Navy, Puget Sound Naval Shipyard, Bremerton, Wash.

THURSDAY AFTERNOON

SEPTEMBER 4

Construction Division

ILLINOIS ROOM, LA SALLE HOTEL

Presiding: A. H. Ayers, M. ASCE; Chairman, Executive Committee, Construction Division, Vice-President, Utah Construction Co., San Francisco, Calif.

2:00 **Mechanization Has Revolutionized Construction Work***

FRANCIS DONALDSON, Vice-President, Mason and Hanger Corp., New York, N.Y.

2:45 **Modern Excavation Methods and Equipment***

H. H. EVERIST, JR., Treasurer Western Contracting Corp., Sioux City, Iowa.

3:30 **Concrete Aggregate, Batching and Mixing Plants***

R. F. BLANKS, M. ASCE; Vice-President and General Manager, Great Western Aggregates, Inc., Denver, Colo.

4:15 **Economies in Concrete Construction Through Improved Techniques**

JOHN R. HARDIN, M. ASCE; Assistant Chief of Engineers for Military Construction, Brig. Gen., U. S. Army, Washington, D.C.

FRIDAY MORNING

SEPTEMBER 5

Air Transport Division

HAVANA ROOM
BLACKSTONE HOTEL

Presiding: Herbert H. Howell, M. ASCE; Civil Aeronautics Administration, Washington, D.C.

10:00 **History of Air Transport Division**

WALTER JOHANNESSEN, M. ASCE; Chairman, Executive Committee, Air Transport Division.

10:30 **History of Aviation**

PAUL E. GARBER, Curator, National Air Museum, Smithsonian Institution, Washington, D.C.

11:15 **Airports**

JOHN M. KYLE, Chief Engineer, Port of New York Authority, New York, N.Y.

Construction—Irrigation and Drainage Divisions, Joint Session

ILLINOIS ROOM, LA SALLE HOTEL

Presiding: W. E. Blomgren, M. ASCE, Assistant Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Symposium—Large Storage Dams and Power Plants

9:30 **Irrigation Division**

K. B. KEENER, M. ASCE; Chief of Dams Branch, Design and Construction Division, Bureau of Reclamation, Denver, Colo.

10:00 **Construction Division**

Ross WHITE, M. ASCE; Engineer and Vice-President, Brown and Root, Houston, Tex.

Symposium—Diversion Structures and Distribution Systems for Irrigation

10:30 **Irrigation Division**

W. H. NALDER, M. ASCE; Chief Designing Engineer, Bureau of Reclamation, Denver, Colo.

11:00 **Construction Division**

J. E. HILL, M. ASCE; Engineer, J. H. Terteling and Sons, Inc., Boise, Idaho.

Highway Division

UPPER TOWER
CONRAD HILTON HOTEL

Presiding: Ben H. Petty, M. ASCE; Chairman, Executive Committee, Highway Division

9:30 **Review of History of the Division**

BEN H. PETTY, M. ASCE; Chairman, Executive Committee, Highway Division.

10:00 **Highway Administration**
T. J. KAUER, M. ASCE, Director, Ohio Department of Highways.

11:00 **Highway Design**
DEWITT C. GREER, M. ASCE; State Highway Engineer, Texas State Highway Dept., Austin, Tex.

HIGHWAY LUNCHEON

Friday, Sept. 5 **12:30 p.m.**

SOUTH BALLROOM
CONRAD HILTON HOTEL

THOMAS H. MACDONALD, HON. M. ASCE, will speak to the luncheon assembly on "The Development and Future of the Science and Art of Highway Engineering." Mr. MacDonald, who is Chief of the U. S. Bureau of Public Roads, will have data of vital interest to all members, guests and friends, who are all cordially invited to attend.

V. E. GUNLOCK, M. ASCE, Commissioner of the Chicago Department of Subways and Superhighways, will preside.

Per plate, $3.50.

FRIDAY AFTERNOON
SEPTEMBER 5

Air Transport Division

HAVANA ROOM
BLACKSTONE HOTEL

Presiding: Alfred J. Ryan, M. ASCE, Consulting Engineer, Denver, Colo.

2:00 **Aircraft**
CARLOS WOOD, Chief of Preliminary Design, Douglas Aircraft.

2:20 **Airways**
JOSEPH D. BLATT, A.M. ASCE; Civil Aeronautics Administration.

2:50 **(a) Future of Airports (panel discussion)**
JOHN R. HARDIN, Assistant Chief of Engineers for Military Construction, Washington, D.C.

(b) Future of Aircraft (panel discussion)
WM. A. PATTERSON, President, United Air Lines.

(c) Future of Airways (panel discussion)
D. K. MARTIN, Director of Development, Air Navigation Development Board, Civil Aeronautics Administration.

Construction—Structural Divisions, Joint Session

ILLINOIS ROOM, LA SALLE HOTEL

Presiding: Lester C. Rogers, M. ASCE, President, Bates and Rogers Construction Corp., Chicago, Ill.

Symposium—Effect of Engineering Design on the Cost of Construction

2:00 **Construction Division**
W. W. WANAMAKER, M. ASCE; Chief Engineer, Orinoco Mining Co., New York, N.Y.

ROSS WHITE, M. ASCE; Vice-President, Brown & Root, Inc., Houston, Tex.

RALPH DE SIMONE, President, Merritt, Chapman & Scott Corp., New York, N.Y.

3:00 **Structural Division**
GLENN B. WOODRUFF, M. ASCE; Consulting Engineer, San Francisco, Calif.

LESLIE N. MCCLELLAN, M. ASCE; Chief Engineer, Bureau of Reclamation, Denver, Colo.

Highway Division

UPPER TOWER
CONRAD HILTON HOTEL

Presiding: Wm. N. Carey, Jr., A.M. ASCE, Secretary, Executive Committee, Highway Division

2:30 **Highway Construction**

3:15 **Highway Maintenance***
REX M. WHITTON, Chief Engineer, Missouri State Highway Department, Jefferson City, Mo.

4:00 **The Changed Picture in Highway Traffic***
D. GRANT MICKLE, M. ASCE; Director, Traffic Engineering Division, Automotive Safety Foundation, Washington, D.C.

MEN'S SMOKER, SHOW

Friday, Sept. 5 **8:00 p.m.**

GRAND BALLROOM
CONRAD HILTON HOTEL

This evening is planned especially for those who want a chance to visit with their friends and widen their circle of acquaintances in the profession. The program will offer top-notch entertainment, for which the Windy City is noted, and refreshments.

Tickets for this event will be $4.00 per person.

All members, their guests and friends of ASCE are cordially invited.

AWARDS LUNCHEON

Saturday, Sept. 6 **12:00 Noon**

GRAND BALLROOM
CONRAD HILTON HOTEL

The program for this luncheon will feature the awards of the Society and Divisions Prizes for outstanding contributions to the literature of the profession to the following:

John Fritz Medal
BENJAMIN F. FAIRLESS, M. ASCE; President and Chairman of U.S. Steel.

Hoover Medal
CLARENCE D. HOWE, M. ASCE; Canadian Minister of Trade, Commerce and Defense Production.

Thomas Fitch Rowland Prize
CLARENCE KEEFER, M. ASCE; Deputy Sewerage Engineer, Baltimore Bureau of Sewers, Baltimore, Md.

James Laurie Prize
JOHN M. KYLE, Chief Engineer, Port of New York Authority.

Collingwood Prize for Juniors
T. WILLIAM LAMBE, J.M. ASCE; Asst. Prof. of Soil Mechanics, M.I.T.

Arthur M. Wellington Prize
BASIL WRIGLEY WILSON, A.M. ASCE; Asst. Research Engineer, South African Railways and Harbors.

J. C. Stevens Award
HAROLD R. HENRY, J.M. ASCE; Research Assoc., Civil Engineering Department, Columbia University.

Leon S. Moisseiff Award
MARIO G. SALVADORI, A.M. ASCE; Assoc. Prof., Civil Engineering Department, Columbia University.

James W. Rickey Medal
DONALD J. BLEIFUSS, A.M. ASCE; Vice-President, International Engineering Co., San Francisco, Calif.

Construction Engineering Prize
JOHN N. NEWELL, M. ASCE; Chief Engineer, Massman Construction Co., Kansas City, Mo.

Per plate, $3.50.

HONORARY MEMBERSHIP DINNER

Saturday, Sept. 6 **7:00 p.m.**

GRAND BALLROOM
CONRAD HILTON HOTEL

Cocktails in the Normandie Lounge, 6:30 p.m.

Featured on the dinner program will be the award of Honorary Membership to:

ANDRE LEON GULES COYNE, M. ASCE, Paris, France.

HARVEY S. MUDD, Los Angeles, Calif.
C. J. MACKENZIE, Ottawa, Canada.
ARY TORRES, Sao Paulo, Brazil.
E. G. BAILEY, New York, N.Y.

An address of congratulation on the Centennial will be delivered by ALLEN QUATERMAINE, President, Institute of Civil Engineers, London, England.

Per plate, $8.50. Formal dress.

STUDENT CHAPTER FACULTY ADVISERS' CONFERENCE

Saturday, Sept. 6

ROOM 1, CONRAD HILTON HOTEL

Faculty Advisers from ASCE Student Chapters in the Middle West will convene for a one-day discussion of Student Chapter problems.

This conference, which is primarily for invited advisers, will be open to all Contact and Junior Contact Members of Chapters, and others interested in the operation of ASCE Student Chapters.

MONDAY MORNING, SEPTEMBER 8

Sanitary Engineering Div.—Engineering Sect. of American Public Health Assn., Joint Session

SOUTH BALLROOM
CONRAD HILTON HOTEL

Presiding: Frank Woodbury Jones (M. ASCE), Chairman, Executive Committee, Sanitary Engineering Division, Harold B. Gotaas (M. ASCE), Professor, Civil Engineering Division, University of California; and E. G. Eggert

9:00 The Sanitary Engineering Division of ASCE—Its History 1923–1952

FRANK WOODBURY JONES, M. ASCE, Chairman, Executive Committee, Sanitary Engineering Division.

9:30 Sanitary Engineering—The Record 1852–1952

E. SHERMAN CHASE, M. ASCE; Metcalf and Eddy, Boston, Mass.

10:30 Problems of Supplying London with Water

HENRY FRANCIS CRONIN, Chief Engineer, Metropolitan Water Board, London, England.

11:15 Joint Committee Report on Advancement of Sanitary Engineering

EARNEST BOYCE, M. ASCE; Chairman, ASCE Committee on Advancement of Sanitary Engineering, Head, Department of Civil Engineering, University of Michigan.

Engineering Mechanics Div.—Applied Mechanics Div. of ASME, Joint Session

UPPER TOWER
CONRAD HILTON HOTEL

Engineering Mechanics Session—A Review of Developments

Presiding: Arthur T. Ippen, M. ASCE, Chairman, Executive Committee, Engineering Mechanics Division

9:30 Engineering Mechanics and Civil Engineering

NATHAN M. NEWMARK, M. ASCE; Research Professor of Structural Engineering, University of Illinois.

10:00 100 Years of Scientific Achievement in the Mechanics of Solids

O. CLAYTON DOHRENWEND, A.M. ASCE; Head, Department of Mechanics, Rensselaer Polytechnic Institute.

11:00 Applied Mechanics and Professional Advancement in Civil Engineering

LINTON E. GRINTER, M. ASCE; Research Professor, Illinois Institute of Technology.

Soil Mechanics and Foundations Division

NORMANDIE LOUNGE
CONRAD HILTON HOTEL

Presiding: R. F. Blanks, M. ASCE, Chairman, Executive Committee, Soil Mechanics and Foundations Division

9:30 Origin and Function of Soil Mechanics

KARL TERZAGHI, Hon. M. ASCE; Professor of Engineering Practice, Harvard University, Cambridge, Mass.

10:30 Progress of Earth Dam Design and Construction*

T. A. MIDDLEBROOKS, A. M. ASCE; Engineer, Soils Branch, Civil Works Office of the Chief of Engineers, Washington, D.C.

ENGINEERING MECHANICS LUNCHEON

Monday, Sept. 8 **12:00 Noon**

West Ballroom, Conrad Hilton Hotel

Sponsored by the Engineering Mechanics Division for the convenience and enjoyment of those interested in the activities of the Division. So that conversations can proceed without interruption, no speeches will be delivered.

Per plate, $3.50.

MONDAY AFTERNOON SEPTEMBER 8

Engineering Mechanics Div.—Applied Mechanics Div. of ASME, Joint Session

UPPER TOWER
CONRAD HILTON HOTEL

Applications of Digital and Analog Computation Session

Presiding: Nathan M. Newmark, M. ASCE, Member, Executive Committee, Engineering Mechanics Division

2:00 High-Speed Digital Computers and Their Application to Engineering Calculation

LOUIS N. RIDENOUR, Vice-President, Engineering International Telemeter Corp., Los Angeles, Calif.

3:00 Digital Computation of Impact—Effects of Smoothly Rolling Loads

LAWRENCE E. GOODMAN, A.M. ASCE; Associate Professor of Civil Engineering; and T. P. TUNG, Assistant Professor of Civil Engineering, University of Illinois.

3:30 Methods of Analog Solutions for Engineering Problems (Preprint 46)

GLENN MURPHY, M. ASCE; Professor of Mechanics, Iowa State College.

4:20 Electrical Analogues of Statically Loaded Framed Structures (Preprint 47)

FREDERICK L. RYDER, Assistant Project Manager, Allen B. DuMont Laboratories, East Paterson, N.J.

Structural Division

NORTH BALLROOM
CONRAD HILTON HOTEL

Presiding: E. C. Hartmann (M. ASCE), Chief Engineer, Design Division, Aluminum Co. of America, Executive Committee, Structural Division; and Douglas McHenry (M. ASCE), Executive Committee, Engineering Mechanics Division, Portland Cement Association

2:30 General Introduction to the Work of the Research Council on Riveted and Bolted Structural Joints (Preprint 48)

W. C. STEWART, Chairman, Research Council on Riveted and Bolted Structural Joints.

2:50 Laboratory Tests of High Tensile Bolted Structural Joints (Preprint 49)

W. H. MUNSE, J.M. ASCE; Research Assistant Professor of Civil Engineering; D. T. WRIGHT, J.M. ASCE; Formerly Research Assistant in Civil Engineering; and N. W. NEWMARK, M. ASCE; Research Professor of Structural Engineering; all of University of Illinois.

3:15 Comparative Behavior of Bolted and Riveted Joints (Preprint 50)

FRANK BARON, A.M. ASCE; Professor of Civil Engineering, Technological Institute; and EDWARD W. LARSON, JR., J.M. ASCE, Research Associate, Civil Engineering; both of Northwestern University, Evanston, Ill.

3:40 Frictional Resistance of Bolted Joints

R. A. HECHTMAN, A.M. ASCE; Associate Professor of Structural Research, University of Washington, Seattle, Wash.

4:05 Rational Explanation of Cause and Remedy for Fatigue Failure in Riveted and Bolted Single-Lap Joints, with Supporting Evidence

J. W. CARTER, J.M. ASCE, Asst. Prof. of Structural Engineering; K. H. LENZEN, J.M. ASCE, Dept. of Civil Engineering and Engineering Mechanics; and L. T. WYLY, M. ASCE; Prof. of Structural Engineering and Head of Dept.; all of Purdue University, Lafayette, Ind.

4:30 Structural Application of High Tensile Bolts*

T. R. HIGGINS, M. ASCE; Director of Engineering, American Institute of Steel Construction, New York; and E. J. RUBLE, M. ASCE, Structural Engineer, Research Staff, Association of American Railroads, Chicago, Ill.

Sanitary Engineering Div.—Engineering Sect. of American Public Health Assn., Joint Session

SOUTH BALLROOM
CONRAD HILTON HOTEL

Presiding: Rolf Eliassen (M. ASCE), Professor of Sanitary Engineering, Massachusetts Institute of Technology; Ralph Fuhrman (M. ASCE), Superintendent, Sewage Treatment Plant, Washington, D.C.; and Dwight F. Metzler (A. M. ASCE), State Board of Health, Lawrence, Kans.

2:00 Municipal Refuse Collection Practice Analyzed*

E. A. PEARSON, A.M. ASCE; Asst. Prof. of Sanitary Engineering; B. P. HASKELL, J.M. ASCE, Research Engineer; and N. B. JONES, Former Research Engineer; all of University of California.

2:30 *Symposium—Outstanding Achievements in Sanitary Engineering*

Moderator: Abel Wolman, M. ASCE; Professor, Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

Water Supply and Treatment*

HARRY E. JORDAN, Aff. ASCE, Secretary, American Water Works Assn. Inc., New York, N.Y.

Stream Pollution

HAROLD W. STREETER, M. ASCE, Consultant, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

Sewage Treatment

A M RAWN, M. ASCE; Chief Engineer and General Manager, County Sanitary Districts, Los Angeles, Calif.

Industrial Wastes

DON E. BLOODGOOD, A.M. ASCE, Purdue University, Lafayette, Ind.

Sanitary Engineering in Government

L. F. WARRICK, Chief, Technical Service Branch, Division of Water Pollution Control, U. S. Public Health Service, Washington, D.C.

Consulting Sanitary Engineering

SAMUEL A. GREELEY, Hon. M. ASCE, Greeley and Hansen, Chicago, Ill.

Sanitation in Latin America

CLARENCE I. STERLING, JR., Chief Engineer, State Dept. of Health, Boston, Mass.

4:15 Report—Committee of Sewerage and Sewage Treatment

KERWIN L. MICK, A.M. ASCE; Chief Engineer and Supt., Minneapolis-St. Paul Sanitation Dist.

Soil Mechanics and Foundations Division

NORMANDIE LOUNGE
CONRAD HILTON HOTEL

Presiding: Hamilton Gray, M. ASCE; Secretary, Executive Committee, Soil Mechanics and Foundations Division

2:30 Geophysics—A Tool of the Engineer

DANIEL LINEHAM, S.J., Seismological Observatory, Weston College, Weston, Mass.

3:15 Interpretation of Soil and Geological Conditions from Aerial Photographs

DONALD J. BELCHER, A.M. ASCE; Director, Aerial Photographic Center, Cornell University, Ithaca, N.Y.

4:00 Geological Analysis of Soil Borings

W. C. KRUMBEIN, Professor of Geology, Northwestern University, Evanston, Ill.; and GEORGE H. OTTO, Vice-President, Subsurface Engineering Corp., Chicago, Ill.

LOCAL SECTIONS

CONFERENCE

Monday, Sept. 8
Tuesday, Sept. 9

9:30 P.M. LOWER TOWER
CONRAD HILTON HOTEL

Representatives of ASCE Local Sections in the Middle West will convene to discuss the expanding program of ASCE at the local level.

This conference, which is primarily for invited delegates of selected Sections, will be open to any and all who may be interested in the operation of ASCE Local Sections

TUESDAY MORNING

SEPTEMBER 9

Engineering Mechanics Div.—Applied Mech. Div. of ASME, Joint Session

UPPER TOWER
CONRAD HILTON HOTEL

Fluid Dynamics Session

Presiding: Ralph E. Fadum, M. ASCE, Executive Committee, Engineering Mechanics Division

9:15 Turbulence and Diffusion as Factors in Sediment Transportation (Preprint 67)

VITO A. VANONI, M. ASCE, Associate Professor of Hydraulics; and EN-YUN HSU, A.M. ASCE, Research Associate, Hydrodynamics Laboratory, California Institute of Technology.

9:55 Wave Theory Applied to Shore and Harbor Structures (Preprint 54)

PIERRE DANEL, A.M. ASCE, Director; and F. BIESEL, Engineer, Neyrpic Laboratories, Grenoble, France.

10:35 Motion of Discrete Particles Along Bed of Turbulent Stream

ARTHUR T. IPPEN, M. ASCE, Prof. of Hydraulics, Mass. Inst. of Technology; and RAMJEE P. VERMA, A.M. ASCE, Prof. of Civil Engineering, Bihar College of Engineering, Patna, India.

11:15 Mechanics of Manifold Flow (Preprint 55)

JOHN S. MCNOWN, A.M. ASCE; Associate Director, Iowa Institute of Hydraulic Research.

Sanitary Engineering Div.—Engineering Sect. of American Public Health Assn., Joint Session

SOUTH BALLROOM
CONRAD HILTON HOTEL

Presiding: B. A. Poole (M. ASCE), State Board of Health, Indianapolis; John C. Bumstead (A.M. ASCE), Secretary, Executive Committee, Sanitary Engineering Division; and Earnest Boyce (M. ASCE), Head, Department of Civil Engineering, University of Michigan

The Real Significance of Sanitary Engineering

9:00 (a) **Health, Welfare and Economic Development**

JOHN A. LOGAN, A.M. ASCE; The Rockefeller Foundation, London, England.

9:20 (b) **The Need to Break with Tradition—Rooted Practices**

RAY DERBY, M. ASCE; Sanitary Engineer, Department of Water Power, Los Angeles, Calif.

9:40 (c) **Future Developments in Sanitary Engineering (Preprint 51)**

HAROLD B. GOTAAS, M. ASCE; Professor, Sanitary Engineering, University of California.

10:00 (d) **Administration—The Key to Effective Application**

VINTON W. BACON, A.M. ASCE; State Water Pollution Control Board, Sacramento, Calif.

10:20 **Radioactivity: Its General Significance and Its Detection in Waterworks Control***

ROY J. MORTON, M. ASCE; Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.

11:00 **Modification in Aeration and Activated Sludge Process**

GAIL P. EDWARDS, M. ASCE; Professor, San. Chemistry, New York University.

11:40 **What's the Outlook for Sanitary Engineers?**

CLARENCE W. KLASSEN, Chief Engineer, Division of Sanitary Engineering, State Dept. of Public Health, Springfield, Ill.

Power Division

WEST BALLROOM
CONRAD HILTON HOTEL

Presiding: Byron O. McCoy, A.M. ASCE; Chairman, Executive Committee, Power Division

9:30 **30 Years—Historical Review of Power Division**

BYRON O. MCCOY, A.M. ASCE; Chairman, Executive Committee, Power Division.

10:00 **100 Years of Water Power***

WILLIAM F. UHL, M. ASCE; President, Chas. T. Main, Inc., Boston, Mass.

10:30 **Evolution of Hydraulic Prime Movers**

D. J. MCCORMACK, retired, York, Pa.

11:00 **A Century's Growth in Development of Dams**

JULIAN HINDS, M. ASCE; General Manager, Chief Engineer, United Water Conservation District, Santa Paula, Calif.

Soil Mechanics and Foundations Division

NORMANDIE LOUNGE
CONRAD HILTON HOTEL

Presiding: Hibbert M. Hill, M. ASCE; Executive Committee, Soil Mechanics and Foundations Division

9:30 **Studies of Bearpaw Shale at a Dam Site in Saskatchewan (Preprint 52)**

ROBERT PETERSON, Soil Mechanics Engineer, Prairie Farm Rehabilitation Administration, Saskatoon, Saskatchewan.

10:15 **Landslides and Engineering Problems in Nespelen Varved Clays of Columbia River Basin (Preprint 53)**

W. H. IRWIN and F. C. WALKER, M. ASCE; U. S. Bureau of Reclamation, Denver, Colo.

11:00 **Foundation Problems in Mexico City**

NABOR CARRILLO, Consulting Engineer, Mexico City, Mex.

Structural Division—American Welding Society, Joint Session

NORTH BALLROOM
CONRAD HILTON HOTEL

Presiding: Raymond Archibald, M. ASCE; Chief, Western Headquarters, U. S. Bureau of Public Roads, San Francisco, Calif.

10:00 **History of the Structural Division**

STEWART MITCHELL, M. ASCE; Chairman, Executive Committee, Structural Division.

10:15 **Steel for Bridges and Buildings**

S. A. GREENBERG, Technical Secretary, American Welding Society.

10:50 **Design and Research—Bridges and Buildings**

LAMOTTE GROVER, M. ASCE; Welding Engineer, Air Reduction Co., New York, N.Y.

11:25 **Fabrication and Construction of Structural Steel for Buildings**

C. L. KREIDLER, Chief Structural Engineer, Lehigh Structural Steel Co., Allentown, Pa.

SOIL MECHANICS LUNCHEON

Tuesday, Sept. 9

12:30 P.M. EXHIBIT HALL
CONRAD HILTON HOTEL

Sponsored by the Soil Mechanics and Foundations Division

CHARLES B. BURDICK, HON. M. ASCE; will address the luncheon. His subject will be "Soil Mechanics in Pioneer Days," a non-technical talk in the lighter vein.

ROBERT F. BLANKS, M. ASCE; Chairman of the Executive Committee, Soil Mechanics and Foundations Division, will preside. All members of ASCE, guests and others interested are cordially invited to attend. Per plate, $3.50.

TUESDAY AFTERNOON, SEPTEMBER 9

Engineering Mechanics Div.—Applied Mech. Div. of ASME, Joint Session

UPPER TOWER
CONRAD HILTON HOTEL

Plasticity and Dynamic Loading Session

Presiding: Clayton O. Dohrenwend, A. M. ASCE; Secretary, Executive Committee, Engineering Mechanics Division

2:00 **Engineering and Scientific Problems of the Strength and Plasticity of Materials**

EGON OROWAN, Professor of Mechanical Engineering, Mass. Inst. of Technology

3:00 **The Importance of Dynamic Loads in Structural Design**

JOHN B. WILBUR, M. ASCE, Head; and ROBERT J. HANSEN, A.M. ASCE, Associate Prof., Dept. of Civil and Sanitary Engineering, Mass. Inst. of Technology.

Hydraulics Division

SOUTH BALLROOM
CONRAD HILTON HOTEL

2:30 **History of Hydraulic Development in Europe**

PROF. J. TH. THIJSEE, Director, Waterloop Kundig Laboratorium, Delft, Holland.

3:30 **Hydraulic Engineer and the Public Welfare**

F. M. DAWSON, Dean, University of Iowa, Iowa City.

Power Division

WEST BALLROOM
CONRAD HILTON HOTEL

Presiding: Byron O. McCoy, A. M. ASCE, Chairman, Executive Committee, Power Division

2:00 Trend Towards Multipurpose Developments*

JAMES S. BOWMAN, M. ASCE; Chief Water Control Planning Engineer, Tennessee Valley Authority, Knoxville, Tenn.

2:45 Development of the Modern Hydroelectric Power Plant (Preprint 56)

ARTHUR T. LARNED, M. ASCE, Civil Engineer; and M. G. SALZMAN, M. ASCE, Chief Hydraulic Engineer, Ebasco Services, Inc., New York, N.Y.

3:30 The Status of Atomic Power

BRUCE R. PRENTICE, Manager, Schenectady Office, Nucleonics Division, General Electric Co., Schnectady, N.Y.

Soil Mechanics and Foundations Division

NORMANDIE LOUNGE
CONRAD HILTON HOTEL

Presiding: W. J. Turnbull, M. ASCE, Waterways Experimental Station, Corps of Engineers, U.S. Army, Vicksburg, Miss., member Executive Committee Soil Mechanics and Foundations Division

2:30 Engineering Properties of Expansive Clays (Preprint 57)

W. G. HOLTZ, M. ASCE, and H. J. GIBBS, J.M. ASCE; both of U.S. Bureau of Reclamation, Denver, Colo.

3:15 A Study of Thirty-Year Settlement Records

PHILIP C. RUTLEDGE, M. ASCE; Consulting Engineer, Moran, Proctor, Mueser & Rutledge, New York, N.Y.; and CARL R. HOLDAMPF, A.M. ASCE, Chief Engineer, Klug & Smith Co., Milwaukee, Wis.

4:00 Foundation Conditions in the Cuyahoga Valley

RALPH B. PECK, M. ASCE; Prof. of Civil Engineering, University of Illinois.

Structural Div.—American Inst. of Steel Construction, Joint Session

NORTH BALLROOM
CONRAD HILTON HOTEL

Presiding: R. N. Bergendoff, M. ASCE, Executive Committee, Structural Division

2:30 The Passaic River Bridge

JONATHAN JONES, HON. M. ASCE; Chief Engineer, Fabricated Steel Construction, Bethlehem Steel Co., Bethlehem, Pa.

Division Street Interchange

3:15 San Francisco's All-Welded Viaduct Points Way to Improved Design*

LEONARD C. HOLLISTER, M. ASCE; Designing Engineer, Bridge Dept., California Division of Highways, Sacramento, Calif.

3:45 Sequence and Continuity Mark Modern Welding Practice*

R. W. BINDER, A.M. ASCE; Chief Engineer, Bethlehem Pacific Coast Steel Corp., Los Angeles, Calif.

4:15 Bridges for the West Virginia Turnpike

E. K. TIMBY, M. ASCE; Howard, Needles, Tammen & Bergendoff, New York, N.Y.

HYDRAULICS RECEPTION

Sponsored jointly by ASCE and ASME Hydraulics Divisions

Tuesday, Sept. 9 5:00–7:00 p.m.

SOUTH BALLROOM
CONRAD HILTON HOTEL

Sponsored by the Hydraulics Division of ASCE, this reception and cocktail party has been provided to facilitate the gathering of members interested in the work of this Division.

WEDNESDAY ACTIVITIES

Throughout the Centennial Day, September 10, an extensive program of events has been planned by the Centennial of Engineering, Inc., for the participation of all attending the Convocation. See the Centennial Program for details. No ASCE groups have planned events for this day.

THURSDAY MORNING, SEPTEMBER 11

City Planning Division

UPPER TOWER
CONRAD HILTON HOTEL

Presiding: C. A. Blessing, Member, Executive Committee, City Planning Division, Chicago Plan Commission, Chicago, Ill.

9:30 History of City Planning Division

HARRY W. ALEXANDER, M. ASCE; Chairman, Executive Committee, City Planning Division, Partner, Harland Bartholomew & Associates, St. Louis, Mo.

10:15 History of City Planning in the United States

ULYSSES S. GRANT, III, A.M. ASCE; President, American Planning and Civic Assn., Washington, D.C.

Irrigation and Drainage Division

NORMANDIE LOUNGE, CONRAD HILTON HOTEL

Presiding: George S. Knapp, M. ASCE, Engineering State Board of Agriculture, Division of Water Resources, Topeka, Kans.

9:30 History of Irrigation and Drainage Division

HAROLD CONKLING, M. ASCE; Chairman, Executive Committee, Irrigation and Drainage Division.

9:45 History of Irrigation in the United States

G. D. CLYDE, M. ASCE; Chief, Div. of Irrigation and Water Conservation, U.S. Soil Conservation Service.

10:45 Planning an Irrigation Project in the United States Today (Preprint 58)

J. W. DIXON, M. ASCE; Director of Project Planning, U.S. Bureau of Reclamation.

Structural Division—American Concrete Institute, Joint Session

NORTH BALLROOM
CONRAD HILTON HOTEL

Presiding: A. E. Cummings, M. ASCE, Chairman, Research Committee, ASCE, Raymond Concrete Pile Co., New York, N.Y.

Welcoming Remarks

A. T. GOLDBECK, M. ASCE, President, ACI; and STEWART MITCHELL, Chairman, Executive Committee, Structural Division, ASCE.

Session on Prestressed Concrete

9:30 A Progress Report on Prestressed Concrete

M. J. HOLLEY, JR., A.M. ASCE; Associate Professor, Structural Engineering, M.I.T.

10:00 Prestressed Members of New York Harbor Pier 57

E. H. PRAEGER, M. ASCE; Madigan-Hyland, New York, N.Y.

10:30 The Design, Construction, and Testing of the Endicott Street Bridge in Danvers, Mass.

J. C. RUNDLETT, Bridge Engineer, Dept. of Public Works, Boston, Mass.

11:00 Caracas (Venezuela) Bridge, Using Freyssinet System

ROBERT SHAMA, Freyssinet Co.

11:30 **Design and Construction of a Fully Vibration-Controlled Forging Hammer Foundation**

J. H. A. CROCKETT, Chartered Civil and Structural Engineer, London, England; and A. M. KLEIN, Aff. ASCE, Assistant Manager, Robert W. Hunt Co., New York, N.Y.

ASCE Structural Division, AREA, ASTM, and ASME, Wood Industries Div., Joint Session

SHERMAN HOTEL

Presiding: L. J. Markwardt, M. ASCE, Assistant Director, U.S. Forest Products Laboratory, Madison, Wis.

Wood Symposium—First Session

9:15 **Wood as an Engineering Material***

L. J. MARKWARDT, M. ASCE; Assistant Director, U.S. Forest Products Laboratory, Madison, Wis.

9:45 **Basic Principles of Structural Grading**

LYMAN W. WOOD, Engineer, U.S. Forest Products Laboratory, Madison, Wis.

10:15 **Working Stresses for Structural Lumber**

R. P. A. JOHNSON, Chief, Division of Timber Mechanics, U.S. Forest Products Lab., Madison, Wis.

10:45 **Commercial Lumber Grades (Preprint 59)**

FRANK J. HANRAHAN, M. ASCE; Chief Engineer, National Lumber Mfrs.' Assn., Washington, D.C.

11:15 **Laminated Timber Permits Flexibility of Design***

A. D. FREAS, A.M. ASCE; Engineer, U.S. Forest Products Lab., Madison, Wis.

Waterways Division

WEST BALLROOM
CONRAD HILTON HOTEL

Presiding: DeWitt L. Pyburn, M. ASCE, Chairman, Executive Committee, Waterways Division

9:30 **History of Waterways Division**

DEWITT L. PYBURN, M. ASCE; Chairman, Executive Committee, Waterways Division.

10:15 **Development of Waterways in the United States**

C. H. CHORPENING, M., ASCE, Asst. Chief of Engineers for Civil Works, Brig. Gen., U.S. Army, Washington, D.C.

11:00 **River Transportation Development**

ALEX W. DANN, A.M. ASCE; Chairman of the Board, Union Barge Line Corp., and CARL B. JANSEN, M. ASCE; President, Dravo Corp.

THURSDAY AFTERNOON

SEPTEMBER 11

City Planning Division

UPPER TOWER
CONRAD HILTON HOTEL

Presiding: H. W. Alexander, M. ASCE, Chairman, Executive Committee, City Planning Division

2:00 **The Replanning and Rebuilding of Our Central Cities**

PAUL OPPERMANN, Director of City Planning, San Francisco, Calif.

2:45 **Planning New Towns—Opportunities and Practices**

ALBERT MAYER, M. ASCE; Architect and City Planner, Chairman of City Planning Committee, American Institute of Architects, New York, N.Y.

3:30 **Our Expanding Cities Demand Good Planning***

LAWRENCE V. SHERIDAN, M. ASCE; Planning Consultant, Indianapolis, Ind.

Irrigation and Drainage Division

NORMANDIE LOUNGE
CONRAD HILTON HOTEL

Presiding: W. E. Blomgren, M. ASCE, Bureau of Reclamation, Denver, Colo.

2:00 **Progress in Irrigation Engineering***

L. N. MCCLELLAN, M. ASCE; Chief Engineer, U.S. Bureau of Reclamation, Denver, Colo.

3:00 **Summary of Water Law in U.S. with Special Reference to Arid States***

S. T. HARDING, M. ASCE; Consulting Engineer, Berkeley, Calif.

ASCE Structural Division, AREA, ASTM, and ASME, Wood Industries Div., Joint Session

SHERATON HOTEL

Presiding: Roger R. Smith, Treasurer, L. B. Ramsdell Co., Gardener, Mass., Chairman, ASME Wood Industries Division, Executive Committee; and W. Burdette Wilkins, Consultant, Ridgewood, N.J.

Wood Symposium—Second Session

2:30 **Plywood Is Engineered Wood**

THOMAS D. PERRY, Engineer in Woodwork, Moorestown, N.J.

3:00 **Changes in Woodworking Machinery**

JUDSON MANSFIELD, Chief Engineer, Greenlee Bros. Co., Rockford, Ill.

3:30 **From Handmade to Production Line Furniture**

NELSON C. BROWN, Past Director, Wood Utilization Courses, New York State College of Forestry, Syracuse, N.Y.

4:00 **History of Woodworking Industry**

FRED F. WANGAARD, Prof. of Forestry, Yale School of Forestry, New Haven, Conn.

Structural Division—American Concrete Inst., Joint Session

NORTH BALLROOM
CONRAD HILTON HOTEL

Presiding: A. E. Cummings, M. ASCE, Chairman, Research Committee, ASCE; Raymond Concrete Pile Co., New York, N.Y.

2:00 **What Do We Need to Know About Prestressed Reinforced Concrete?**

N. W. NEWMARK, M. ASCE; Research Professor of Structural Engineering, University of Ill.

2:30 **Prestressed Concrete in Tampa Bay Bridge**

W. E. DEAN, A.M. ASCE; Engineer of Bridges, State Road Department, Tallahassee, Fla.

3:00 **New Design and Construction Methods for Prestressed Concrete**

CURZON DOBELL, M. ASCE; President, Preload Enterprises, Inc., New York, N.Y.

3:30 **Portland Cement Association Program of Investigation of Prestressed Concrete and Results of Some Bond Tests**

JACK R. JANNEY, Assoc. Development Engineer, Structural Development Section, Portland Cement Assn., Chicago, Ill.

4:00 **Progress in Prestressed Concrete Construction**

JOSEPH F. JELLEY, M. ASCE; Chief, Bureau of Yards and Docks, Rear Admiral, USN, Washington, D.C.

Waterways Division

WEST BALLROOM
CONRAD HILTON HOTEL

Presiding: W. O. Hiltabidle, M. ASCE, Rear Admiral, U.S. Navy, Executive Committee, Waterways Division, San Diego, Calif.

2:00 **One Hundred Years of Naval Dry-Dock Construction**

J. R. AYERS, M. ASCE; Head of Waterfront Structure Section, Bureau of Yards and Docks, U.S. Navy.

2:30 **Waterways of Chicago**

RALPH L. BLOOR, M. ASCE; Office of Chief of Engineers, Dept. of the Army.

3:00 **Inland Waterway Transportation and National Defense**
CHESTER C. THOMPSON, President, American Waterways Operators.

3:30 **Motion Picture: The Master Element**

THURSDAY EVENING

SEPTEMBER 11

ASCE Structural Division, AREA, ASTM, and ASME, Wood Industries Div., Joint Session

SHERATON HOTEL

Presiding: J. W. Kendrick, Met-L-Wood Corp., Chicago, Ill., and Thomas D. Perry, Engineer in Woodwork, Moorestown, N.J.

Wood Symposium—Third Session

8:00 **Developments in Cutting Tools**
EDGAR K. SPRING, Chief Metallurgist, Henry Disston and Sons Co., Philadelphia, Pa.

8:30 **Improvement of Wood by Chemical Treatment**
GEORGE W. HUNT, Past Director, Forest Products Laboratory, Madison, Wis.

9:00 **Waste Utilization**
ARMIN ELMENDORF, President, Elmendorf Research, Inc., Chicago, Ill.

FRIDAY MORNING

SEPTEMBER 12

Structural Division—American Concrete Inst., Joint Session

NORTH BALLROOM
CONRAD HILTON HOTEL

Presiding: Stewart Mitchell, M. ASCE, Chairman, Executive Committee, Structural Division

9:30 **Precast Concrete Offers New Possibilities for Design of Shell Structures**
PIER LUIGI NERVI, Consulting Engineer, Nervi & Bartoli, Rome, Italy; presented by Mario Palmieri, M. ASCE, Civil Engineer, Sargent and Lundy, Chicago, Ill.

10:15 **Reinforced Concrete Shell Construction**
CHARLES S. WHITNEY, M. ASCE; Consulting Engineer, Ammann & Whitney, Milwaukee, Wis.

11:00 **Analysis and Tests of a Cylindrical Shell Roof Model**
BRUNO THURLIMANN, Fritz Engineering Laboratory, Lehigh University, and BRUCE G. JOHNSTON, M. ASCE; Professor of Structural Engineering, University of Michigan.

ASCE Structural Division, AREA, ASTM, and ASME, Wood Industries Div., Joint Session

CONRAD HILTON HOTEL

Presiding: George E. Brandow (A.M. ASCE), Member, Executive Committee, Structural Division, Consulting Engineer, Brandow & Johnston, Los Angeles, Calif., ASCE Structural Div., Executive Committee; and C. G. Grove, Chief Engineer, Western Div., Pennsylvania Railroad, Chicago, Ill.

Wood Symposium—Fourth Session

9:30 **Railways (Preprint 60)**
H. AUSTILL, M. ASCE; Chief Engineer, Terminal Railroad Assn., St. Louis, Mo.

10:00 **Industry**
CLARKE C. HERITAGE, Director of Development, Weyerhaeuser Timber Co., Tacoma, Wash.

10:30 **Ships**
A. E. LUDERS, SR., President, Luders' Marine Constr. Co., Stamford, Conn., Shore Structures.

11:00 **Advancement in Technical Abilities**
ALGERT D. ALEXIS, M. ASCE, Rear Admiral, USN; Director of Atlantic Division, Navy Bureau of Yards and Docks, New York, N.Y.

11:30 **Improvements in Structures**
CHARLES A. CHANEY, Project Manager, Graving Docks, Navy Bureau of Yards and Docks, Washington, D.C.

Surveying and Mapping Division

UPPER TOWER
CONRAD HILTON HOTEL

Presiding: S. A. Bauer, A.M. ASCE, Member, Executive Committee, Surveying and Mapping Division

9:00 **The Surveying and Mapping Division (Preprint 61)**
W. H. RAYNER, M. ASCE; Chairman, Executive Committee, Surveying and Mapping Division, Professor of Civil Engineering, University of Illinois.

9:30 **Surveying and Mapping in Canada**
F. H. PETERS, M. ASCE; Chief, Surveying and Mapping Bureau, Dept. of Mines and Resources (Retired), Dominion of Canada, Quebec, Canada.

10:00 **Electronics in Surveying (Preprint 62)**
Carl I. Aslakson, M. ASCE; Commander, U.S. Coast and Geodetic Survey, Washington, D.C.

10:30 **Cartography**
HELMUTH BAY, Rand McNally Co., Washington, D.C.

11:00 **The Evolution of Education in Surveying and Mapping**
GEORGE H. HARDING, A.M. ASCE; Director, Mapping and Charting Research Lab.; Executive Director, Inst. of Geodesy, Photogrammetry and Cartography, Ohio State Univ., Columbus, Ohio.

Waterways Division

WEST BALLROOM
CONRAD HILTON HOTEL

Presiding: DeWitt L. Pyburn, M. ASCE, Chairman, Executive Committee, Waterways Division

9:30 **Economic Aspects of Water Transportation**
H. R. FAISON, M. ASCE; Engineer Consultant, International Bank for Reconstruction and Development.

10:15 **History and Future of Flood Control**
GEORGE R. SCHNEIDER, A.M. ASCE; Head Civilian Engineer, District Engineer's Office, Corps of Engineers, Little Rock, Ark.

11:00 **One Hundred Years of Improvement on the Lower Mississippi River**
PETER A. FERINGA, M. ASCE; President, Miss. River Commission; and CHARLES W. SCHWEIZER, Special Engineer, Asst. to the President, Miss. River Commission.

FRIDAY AFTERNOON

SEPTEMBER 12

Structural Division—American Concrete Inst., Joint Session

NORTH BALLROOM
CONRAD HILTON HOTEL

Presiding: Stewart Mitchell, M. ASCE, Chairman, Executive Committee, Structural Division

2:00 **Construction Aspects of Thin-Shell Structures**
ANTON TEDESKO, M. ASCE; Manager, Structural Dept., Roberts and Schaefer Co., Chicago, Ill.

2:45 **Precast Concrete Boxes in New York Harbor Pier 57**
E. H. PRAEGER, M. ASCE; Madigan-Hyland, New York.

3:30 **Precast Concrete in Highway Bridge Construction**
E. L. ERICKSON, Chief, Bridge Branch, Bureau of Public Roads, Washington, D.C.

4:15 **A Progress Report on Fire Resistance of Concrete Floor Slabs**
J. P. THOMPSON, Portland Cement Assoc., Chicago, Ill.

ASCE Structural Division, AREA, ASTM, and ASME, Wood Industries Div., Joint Session

LOWER TOWER
CONRAD HILTON HOTEL

Presiding: George E. Brandow, A. M. ASCE; Member, Executive Committee, Structural Division

Wood Symposium—Fifth Session

2:30 A Survey of Timber Highway Bridges in the United States*
RAYMOND ARCHIBALD, M. ASCE; Chief, Western Headquarters, U.S. Bureau of Public Roads, San Francisco, Calif.

3:00 Structural Fabrication
WARD MEYER, General Manager, Timber Structures, Inc., Portland, Ore.

3:30 Schools (Preprint 63)
HARRY W. BOLIN, M. ASCE; Principal Structural Engineer, State Division of Architecture, Los Angeles, Calif.

4:00 Buildings
WILLIAM H. SCHEICK, Executive Director, Building Research Advisory Board, National Research Council, Washington, D.C.

Surveying and Mapping Division

UPPER TOWER
CONRAD HILTON HOTEL

Presiding: W. H. Rayner, M. ASCE, Chairman, Executive Committee, Surveying and Mapping Division

2:00 Cadastral Surveys in the United States (Preprint 64)
WILLIAM H. RICHARDS, M. ASCE; Chief, Branch of Surveys, Bureau of Land Management, Washington, D.C.

2:30 Geodetic Surveying (Preprint 65)
H. W. HEMPLE, M. ASCE; Chief, Division of Geodesy, U.S. Coast and Geodetic Survey, Washington, D.C.

3:00 Surveying Instruments
L. C. HIGBEE, President, W. & L. E. Gurley Co., Troy, N.Y.

3:30 Topographic Surveying and Mapping (Preprint 66)
R. H. LYDDAN, A.M. ASCE; Chief of Planning Branch, Topographic Div., U.S. Geological Survey, Washington, D.C.

4:00 Photogrammetry Comes Into Its Own*
GEORGE D. WHITMORE, M. ASCE; and MORRIS M. THOMPSON, both of U.S. Geological Survey, Washington, D.C.

Waterways Division

WEST BALLROOM
CONRAD HILTON HOTEL

Presiding: W. O. Hiltabidle, M. ASCE; Executive Committee, Waterways Division

2:00 Development of Tennessee River Waterway
C. E. BLEE, M. ASCE; Chief Engineer, Tennessee Valley Authority.

2:45 Multiple Purposes Development in the Missouri Basin
DON G. SHINGLER, Division Engineer, Corps of Engineers, Omaha, Nebr.

3:30 The Development of Hydraulic Dredges*
CARL H. GIROUX, Office of Chief of Engineers, Dept. of the Army.

COLLEGE REUNIONS SCHEDULED

University of Illinois Alumni

A 25th annual reunion dinner of all civil engineering graduates of the University of Illinois will be held at 7 p.m., in the Upper Tower Room of the Conrad Hilton Hotel, on Tuesday, September 9. This dinner, usually held at the time of the ASCE New York Convention, will take place this year in connection with the Centennial of Engineering.

Illinois Institute of Technology Chapter of Chi Epsilon

Illinois Institute of Technology will be host to the 1952 conclave of Chi Epsilon at the Illinois Room, La Salle Hotel, Friday, September 12, at 6:15 p.m. This twelfth conclave will mark the 30th anniversary of the founding of Chi Epsilon.

Cornell Society of Engineers

On Friday, Sept. 5, at 4 p.m., the Cornell Society of Engineers will sponsor a program at the Lake Shore Club, in observance of the Centennial of Engineering. DR. C. C. FURNAS, Director of the Cornell Aeronautical Laboratory in Buffalo, will speak on "Future Trends in Aviation." Dinner, at 7 p.m., will be preceded by cocktails. DEAN S. C. HOLLISTER, of the Engineering College at Cornell, will speak following dinner on the "Outlook for Engineering Education."

For further information and reservations for the dinner, contact WILLIAM J. MAUER, 503 North LaSalle Street, Chicago (telephone MOhawk 4-5030 or Evanston: UNiversity 4-7652), Vice-President of the Cornell Society of Engineers and Chairman of the Chicago Branch.

Visit the Exhibits!

Throughout the days of the Convocation, an extensive variety of exhibits will be on display in the Writing Room of the Conrad Hilton Hotel. These exhibits are sponsored by the several Technical Divisions of ASCE and will add considerable visual significance to the programs offered.

Hotel Accommodations

Headquarters for the ASCE Centennial Convocation will be in the Conrad Hilton Hotel, September 3 through 13. Many have secured their reservations for hotel facilities at this early date. Every hotel in the Chicago area has special commitments during Convocation, for some 55 organizations have scheduled functions in Chicago during these days. Obviously, to assure reservations, requests must be filed at once.

For reservations at the Conrad Hilton, send your request to: Conrad Hilton Hotel, Reservation Manager, Chicago 5, Ill., or use the handy coupon on page 107 of this issue. For reservations at any other hotel of your choice, write directly to the reservation clerk at that hotel. In any event, mention your participation in the Centennial and membership in ASCE, for all hotels have set aside blocks of rooms for such use.

Information and Registration

Information and Registration facilities will be maintained on the 3rd Floor of the Conrad Hilton Hotel. Mail and messages will be held for members at the Information Desk, and posting of notices will be an added service.

PRESS OFFICE

Throughout the days of the Convocation, ASCE will maintain a press office in Room 5 at the Conrad Hilton Hotel. Services to the press and public relations activities of the Society will center in this facility.

CENTENNIAL CONVENTION COMMITTEES

HOWARD F. PECKWORTH, *Chairman*
NATHAN B. BEDERMAN, *Vice-Chairman*
JOHN P. GNAEDINGER, *Secretary*
LOUIS R. HOWSON, *Board Contact Member*

Awards and Ceremonies
GEORGE I. UITTI, *Chairman*
Louis R. Howson Howard F. Peckworth

Entertainment
E. M. FUCIK, *Chairman*

W. R. Barrows	Paul Rogers
R. D. Harza	Lee Schlesinger
B. A. Moore	Anton Tedesko
R. M. Patterson	C. H. Welder
F. A. Randall, Jr.	T. W. Van Zelst

Excursions (Advisory)
JOHN G. DUBA, *Chairman*

Finance
HENRY MILLER, *Chairman*
L. L. Edlund George B. Massey
John F. Seifried

Hotel Arrangements
THOMAS K. BREITFUSS, *Chairman*

Reception
CHARLES B. BURDICK, *Chairman*
JOHN F. SEIFRIED, *Vice-Chairman*

D. N. Becker	D. A. Leach
I. E. Boberg	J. deN. Macomb
C. M. Briggs	V. O. McClurg
W. E. Busse	W. M. McConnell
J. C. Chaderton	R. V. McGrath
W. W. DeBerard	C. A. Metz
G. T. Donoghue	E. E. Michaels
E. J. Fucik	C. H. Mottier
F. G. Gordon	C. W. Muhlenbruch, Jr.
S. A. Greeley	C. S. Pillsbury
E. Hancock	H. P. Ramey
L. F. Harza	A. P. Reichmann, Sr.
C. W. Haupt	Lester C. Rogers
K. V. Hill	P. Sawyer
G. L. Jackson	Harry E. Schlenz
P. E. Langdon	I. L. Wissmiller

L. P. Zick, Jr.

Printing
A. L. R. SANDERS, *Chairman*

Publicity
J. ROLAND CARR, *Chairman*

Registration
MARJORIE L. CONGLETON, *Chairman*
Peggy Hoellen Marion Weinstock
Lila Spannenberg

Student Activities
W. S. HAMILTON, *Chairman*
Richard Gnaedinger J. O. Osterberg

Technical Program Coordination
G. DONALD KENNEDY, *Chairman*
Hubert C. Persons H. F. Sommerschield

Technical Program Physical Arrangements
A. L. R. SANDERS, *Chairman*

Murray Blanchard	B. A. Moore
N. F. Brunkow	T. M. Niles
K. L. DeBlois	Marie Palmiero
E. I. Fiesenheiser	R. Patterson
A. L. Holway	F. E. Peacock
A. W. Howson	Paul Rogers
C. J. McLean	H. H. Sonderegger

Anton Tedesko

Ladies Activities
MRS. HOWARD F. PECKWORTH, *Chairman*
Mrs. Nathan B. Bederman
Mrs. I. E. Boberg
Mrs. Julian C. Chaderton
Mrs. Samuel M. Clarke
Mrs. Frank W. Edwards
Mrs. E. M. Fucik
Mrs. J. E. Hirsch
Mrs. Louis R. Howson
Mrs. G. Donald Kennedy
Mrs. Charles H. Mottier
Mrs. Henry Miller
Mrs. T. M. Niles
Mrs. H. C. Persons
Mrs. A. L. R. Sanders
Mrs. H. F. Sommerschield
Mrs. George S. Salter
Mrs. George I. Uitti

LADIES' ENTERTAINMENT

The Ladies' Entertainment Committee welcomes you to Chicago and has arranged this program for your pleasure in the hope that you will enjoy keenly each function and will have a thoroughly pleasant time.

Ladies' Reception Room

This room at the Conrad Hilton Hotel will be open for you daily from 9:00 a.m. to 5:00 p.m. Please check the program for number of room. There will be a daily Coffee Hour from 9:30 a.m. to 10:30 a.m. in the Ladies' Reception Room. Plan to attend this function each day as it will be a delightful starter for your day.

The General Information Desk will have a professional attendant on duty daily during the hours the Ladies' Reception Room is open. Guide books, radio broadcast tickets, programs, descriptive folders on Chicago, and many other things of interest will be available at this desk.

Foreign Guests

A special hostess and linguists wil be in the Ladies' Reception Room daily to be of assistance to you in every way to make your visit more enjoyable.

General Information

There are several functions on the general program that will be of interest to you. Ladies are cordially invited to attend the Awards Luncheon on Saturday, Sept. 6. Check the program for more detailed information.

The Coffee Hour

9:30–10:30 a.m. daily, Sept. 3–12

Please plan to attend this delightful function that has been arranged just for you! Each day there will be an informal talk given on the points of interest in Chicago, on the general program by a professional lecturer. Make this hour the time to get acquainted with the hostesses, and the Ladies' Reception Room the place to greet your friends.

Wednesday, Sept. 3, the Coffee Hour will be held in the Ladies' Reception Room, Room 19, 4th floor.

Thursday, Sept. 4 and Friday, Sept. 5, the Coffee Hour will be held in the Ladies' Reception Room, Room 18, 4th floor.

Saturday, Sept. 6 through Friday, Sept. 12, the Coffee Hour will be held in the Ladies' Reception Room, Room 2, 3rd floor.

Columbia Yacht Club Luncheon

Thursday, Sept. 4 **1:00 p.m.**

A luncheon honoring the wives of the Past Presidents, of the Board of Direction members, and of Foreign Guests, overlooking beautiful Yacht Basin—truly a delightful setting. Meet in the Ladies' Reception Room, Room 18, 4th floor, at 12:30 p.m. for bus transportation to and from the Columbia Yacht Club.

Dinner and Opera at the Kungsholm

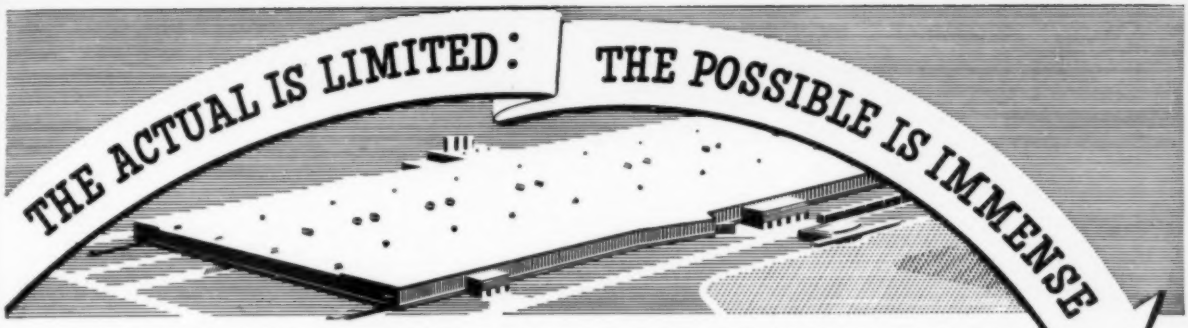
Friday, Sept. 5 **6:30 p.m.**

Plan to attend this dinner. The Kungsholm is a rare treat for everyone. Its appointments are beautiful, its smorgasbord sumptuous, and the Puppet Grand Opera is world renowned. Meet in the Ladies' Reception Room, Room 18, 4th floor, at 6:00 p.m. for bus transportation to and from the Kungsholm. Tickets available at the General Registration Desk.

Tea and Book Parade

Tuesday, Sept. 9 **3:00 to 5:00 p.m.**

Tea will be served in the Ladies' Reception Room, Room 2, and a delightful review of the new fall Book Parade will be given for your enjoyment. Set aside this afternoon for sheer enjoyment.



NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

© LE Co. 1952

WELDED RIGID FRAME DESIGN SAVES 20% STEEL ...CUTS COST 8%

By **A. M. Strauss,** Architect
Fort Wayne, Indiana

THE new $3,000,000 Allen County Memorial Coliseum with its 224′ clear span is one of the largest rigid-frame structures in the country. By eliminating interior columns, that would have been necessary had a system of trusses been used, the rigid frame design has cut steel requirements by 20%. From past experience with this type of construction, an overall saving of 8% is anticipated over riveted design.

The 1200 ton structure consists of 10 rigid frames, each weighing approximately 67 tons. These frames are shop-fabricated in five unit sections of columns, rafters and crown sections. After delivery to the site, the three center sections are spliced on the ground before erecting. All field splices were made with the frame in a vertical position. Best erection time was two frames per week, using track-mounted erection towers for the ground welding of the center sections.

Total structural weight is 1246 tons, costing $230,000. The unit erection cost per frame is $3400, which averages $50 per ton.

HOW TO DESIGN ARC WELDED STRUCTURES
Latest data on calculations, procedures and costs are found in the new 9th Edition Procedure Handbook of Arc Welding Design and Practice. Price only $2.00 postpaid in U.S.A.; $2.50 elsewhere.

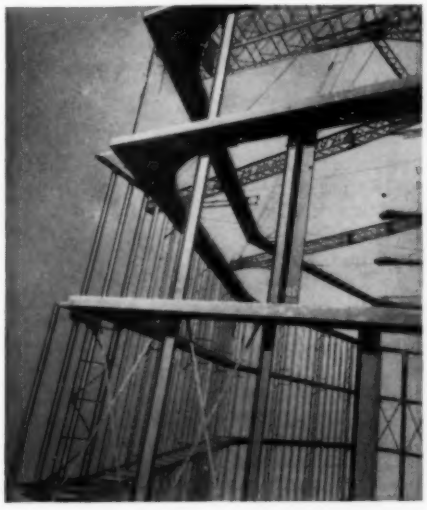


Fig. 3—Allen County War Memorial Coliseum, *Fort Wayne, Indiana. Fabricators: The Fort Wayne Structural Steel Company; General Contractor: Hagerman Construction Company; Erectors: Martin Erecting Company and The Machinery Company.*

WELDED DESIGN ALWAYS SAVES STEEL AND LOWERS COST

Fig. 1—Cuts Fabricating Costs—*Plate sections for columns and rafters are flame cut, drawn up by sledging and wedging, then tack welded with Lincoln "Fleetweld 5"* electrodes, using "Shield-Arc"* motor-driven arc welders.*

Fig. 2—Speeds Welding—*Webs and flanges are fillet welded with "Manual Lincolnweld" at speeds of 26 to 30 inches per minute. Average time to fillet weld one side of 71 foot rafter is 90 minutes.*

**Preferred standards for electrodes and welders on quality work.*

HERE'S HOW

Studies in Structural Arc Welding free on request. Designers and engineers write on your letterhead to Dept. 143,

THE LINCOLN ELECTRIC COMPANY

CLEVELAND 17, OHIO

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

SOCIETY NEWS

Details of Pageant, Technical Exhibits, Other Centennial Features Announced

Final word about the spectacular musical show being staged this summer as an adjunct of the ASCE Centennial program, more details of the technical exhibits being set up in the Museum of Science and Industry, and a miscellany of information on the Convocation program are announced by Lenox R. Lohr, president of the Centennial of Engineering, Inc.

To assure proper public awareness of the significance of the ASCE Centennial celebration, with its culminating convocation in Chicago, September 3–13, Governor Adlai E. Stevenson of Illinois has issued a proclamation urging the participation of the people of the city and the state in the "great Centennial of Engineering," and requesting them "to do their part in making the occasion a memorable success."

Maj. Lenox R. Lohr, president, Centennial of Engineering, 1952, Inc., is pictured immediately above, and above him is shown Frank W. Edwards, general manager of Centennial.

Musical Pageant Opens

The musical extravaganza that has been planned as a means of dramatically portraying the panorama of man's advance by the utilization of engineering and scientific achievements, is entitled "Adam to Atom." Opened in the air-conditioned main theater of the Chicago Museum of Science and Industry on July 16, the show was pronounced by the *Chicago Tribune* "one of the most astounding musical shows ever seen." It will continue to play two and three performances daily throughout the summer season. With a large cast depicting over 300 character roles, the story of man's rise from caveman days to the present development of atomic power will be presented in 27 scenes. One of the scenes graphically depicts "the nation's first organization of engineers on an established career basis," with a portrayal of the first meeting of the American Society of Civil Engineers in New York in 1852. An extensive stage with three revolving sections implements the fast action of the drama. Costumes for the several hundred character parts are exact replicas of those worn in all stages of the history of man.

"Adam to Atom" depicts in an exciting and entertaining way the search by engineers down through the ages for methods and machines to make man's labors less and his living standards higher. It shows in a way even children can understand how our nation, through engineering and a free, competitive, industrial economy has become great and enjoys the highest living standards in the world.

Thousands of youngsters from grade and high schools visit the museum every year. It is to these younger people that the propaganda element of "Adam to Atom" is directed. Major Lohr says "This is the principal audience we wish to reach." The deterring effect to young people of the necessary admission price (60 cents) has prompted several Chicago organizations to sponsor student parties to attend the show. Major Lohr suggests that engineers wishing to contribute toward the financing of such parties may send contributions of $1.00 or more to the Centennial of Engineering Corporation, Museum of Science and Industry.

Howard F. Peckworth, chairman, General Arrangements, is shown upper left and G. Donald Kennedy, chairman, Coordinating Committee on Technical Programs, upper right. E. L. Chandler, Convocation Manager, at right.

Technical Exhibits

As this issue goes to press, final touches are being given a first-hand demonstration of "the technical, economic and social factors that make the country tick" in the form of the Centennial of Engineering exhibit, set up on the balcony of the Museum of Science and Industry. The exhibit will ably reinforce the general story told by industrial exhibits already in existence at the museum. It will occupy 10,400 sq ft of floor space.

Some of the exhibiting firms, with the highlights of their exhibits, include the Westinghouse Electric Co., which has supplied an electric staircase to carry visitors to the balcony area; the Aluminum Company of America, which will show by an animated model a new construction technique utilizing the peculiar advantages of aluminum as a structural material; and the International Harvester Co., that will demonstrate the significance of mechanized farming by showing how the percentage of the population required to feed the nation has been reduced from 84 percent to 16 percent in the past hundred years by the increased use of machinery.

General Motors will demonstrate how radically the tempo of our national life has changed in the past half century by

developments in transportation. The world's largest lighting unit, a 50,000-w lamp, as well as the world's smallest lamp, especially made for surgical purposes, will be the focal attractions of the General Electric Company's section.

ASCE Centennial Day

Presentation of awards for outstanding papers will be featured at a general luncheon on ASCE Centennial Day, Saturday, September 6, as will ceremonies connected with release of the ASCE commemorative stamp. An official of the Post Office Department will speak. The dinner that evening will feature conferring of five honorary memberships in ASCE, and an address by Allen S. Quartermaine, president of the British Institute of Civil Engineers.

Centennial of Engineering Day

Scrolls and plaques will be presented to ASCE by representatives of engineering societies all over the world at the Centennial Day luncheon on Wednesday, September 10. Presentation of the Hoover Medal to C. D. Howe, M. ASCE, and the John Fritz Medal to Benjamin Fairless, M. ASCE, will be another feature of the Centennial Day luncheon. ASCE Honorary Member Charles F. Kettering will be the principal speaker at an informal dinner at the International Amphitheater that evening. The program will end with a 1953 Sonja Henie Ice Show.

Conference on Manpower Utilization

Manpower utilization and national security will be the theme of a conference to be held at the Conrad Hilton Hotel in Chicago on Sunday, September 7, as a feature of the ASCE Centennial Convocation. Sponsored by the Engineering Manpower Commission of Engineers Joint Council in cooperation with the Western Society of Engineers, the conference will feature a talk by Carey H. Brown, chairman of the Engineering Manpower Commission. Mr. Brown will explain the position of the Commission with respect to such important manpower problems as universal military training, expanded R.O.T.C. proposals, unified reserve legislation, selective service, and industrial utilization of specialized personnel in short supply.

New Members on Centennial Board

Two more members have been added to the board of directors of the Centennial of Engineering, which already includes the nation's leading engineering and scientific personnel. The latest additions are Alva W. Phelps, chairman of the Oliver Corp., Chicago, and Harry A. Winne, vice-president of the General Electric Co., Schenectady, N.Y.

Induction of Five New Honorary Members to Be a Centennial Convocation Feature

At its Denver meeting the ASCE Board of Direction elected to honorary membership five outstanding engineers. In keeping with the broad and international character of its forthcoming Centennial Convocation in Chicago, at which presentation of the honorary memberships will be made, the Board of Direction has selected for this year's awards two engineers prominent in other branches of the profession—Ervin G. Bailey, past-president of ASME, and Harvey S. Mudd, former president of AIME—and three distinguished foreign engineers—André Coyne of France, Chalmers J. Mackenzie of Canada, and Ary F. Torres of Brazil. Presentation of the honorary memberships will be one of the features of a dinner at the Conrad Hilton Hotel on ASCE Centennial Day, Saturday, September 6.

Highlights in the careers of the five new honorary members follow.

Ervin George Bailey

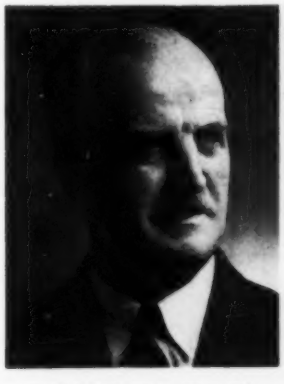
The more efficient industrial utilization of coal, with the specific objective of conserving this natural resource, has been Ervin G. Bailey's major field of interest since his engineering college days. His more outstanding accomplishments include the development of a boiler meter as an aid to efficient combustion. This meter, now used all over the world, is built by the Bailey Meter Co., which he founded. The development of a form of protected water-cooled furnace wall construction bearing his name is another of his contributions to the conservation of coal. He has also made important contributions in the fields of pulverized coal firing and boiler and furnace design, practical applications of the slag-type furnace, the two-stage furnace and open-pass boiler, inter-tube burners, pulverizers, and the direct firing of pulverized coal in high-capacity boilers.

A mechanical engineer and former president of The American Society of Mechanical Engineers, Mr. Bailey received an M.E. degree from Ohio State University in 1903. His early experience included four years in the Testing Department of the Consolidation Coal Co., Fairmont, W. Va., two years in charge of the Coal Department of Arthur D. Little, Boston, and six years as a partner in the Fuel Testing Company, Boston. In 1915 he founded and became president of the Bailey Meter Company, Cleveland, Ohio, and from 1926 to 1935 he was president of the Fuller Lehigh Co. Since 1930 he has been vice-president of the Babcock & Wilcox Co., in New York, with which the Fuller Lehigh Co. was merged.

The award of honorary membership in ASCE to Mr. Bailey is the culmination

E. G. Bailey, Hon. M.

André Coyne, Hon. M.



C. J. Mackenzie, Hon. M.

Harvey S. Mudd, Hon. M.

American Brazilian Association

Ary F. Torres, Hon. M.

of a long series of professional honors bestowed upon him. Long a member of ASME, Mr. Bailey received the ASME Medal in 1942 for "achievement and leadership in steam and combustion engineering," and in 1948 he was president of ASME. Other recent honors include honorary membership in the Institute of Mechanical Engineers of Great Britain, the 1952 award of the John Fritz Medal "for outstanding engineering achievement." He assisted in the organization of Engineers Joint Council, and has been chairman of its Engineering Manpower Commission. In both EJC and the American Society for Engineering Education, his interest and leadership in the education field have been a potent factor. Mr. Bailey holds honorary engineering doctorates from Lehigh University and Ohio State University, and the degree of doctor of science from Lafayette College, and has made many contributions to the technical press.

André Coyne

An outstanding designer and builder of dams, André Coyne, M. ASCE, consulting engineer of Paris, France, is noted also for his achievements in the fields of port and maritime structures and bridges. His early education at the Ecole Polytechnique was interrupted by four years of service as an Engineer and Air Corps officer in World War I, for which he was awarded the Croix de la Legion d'Honneur. After the war he completed his training at the Ecole Nationale des Ponts et Chaussees.

From 1920 to 1928 Mr. Coyne was civil engineer for the Port of Brest, serving with the great French engineers, Caquot and Freyssinet. His work in this capacity included perfecting a new and ingenious device for retaining structures (wall facings anchored to the base itself by means of ties), first tests on auscultation of structures by means of vibrating chords, and supervision of construction of the large Plougastel Bridge designed by Freyssinet.

Becoming chief engineer of the Upper Dordogne Development Service in 1928, Mr. Coyne started his notable career as designer and builder of dams. His first structures were the arch cofferdam at Saint-Etienne-Cantales, which has a length equal to five times its height, and the high, slender structure at Mareges. Since then he has been constantly improving the technique of the arch dam, the type best suited to most French valleys. He has built dams at l'Aigle, Bort, le Chastang, and Tignes, several high-arch dams in Portugal and North Africa, and several multiple-arch dams with large spans in France. In l'Aigle Dam he incorporated one of his most notable inventions, the ski-jump spillway, which has since been duplicated on other French dams. To strengthen Cheurfas Dam in Algeria he used 37 steel cables tensioned up to 1,000 tons each, and anchored to a soft sandstone foundation. In all he has built more than 50 dams, his structures including Europe's tallest dam currently being built in the Alps.

Mr. Coyne was appointed head of the French Technical Service for Large Dams in 1935, and Inspector General of Bridges and Roads in 1943. He is now a private consulting engineer to most of the French technical government departments and to several foreign governments. Since 1946 he has been president of the French National Committee and of the International Commission on Large Dams, presiding over the international meetings held in Stockholm in 1948 and in New Delhi in 1951. He has contributed to French periodicals and lectured widely on dam design and construction.

Chalmers Jack Mackenzie

Chalmers J. Mackenzie, member and past-president of the Engineering Institute of Canada, is widely known throughout the Dominion for his professional accomplishments. He received his B.E. degree from Dalhousie in 1909 and his MCE from Harvard in 1915. He began his career in the Maritime Provinces, but soon went west as resident engineer in charge of the construction of three municipal electric plants. He inaugurated engineering courses at the University of Saskatchewan, and was appointed professor of civil engineering in 1915. From 1916 to 1918 he was overseas with the Canadian Expeditionary Forces, and was awarded the Military Cross for his services.

From 1919 to 1939 Dr. Mackenzie carried out a great variety of activities, including university work and a consulting practice. His work at the university included a period as dean of engineering. In 1935 he was appointed to the Advisory Council of the National Research Council, and in 1939 was made acting president. Since 1944 he has been president of the Council and director of industrial research and development in the national Department of Reconstruction. As president of the Research Council, Dr. Mackenzie is an ex-officio member of the interim defence research board recently established at Ottawa. At present he is president of Atomic Energy of Canada, Ltd., the Canadian organization corresponding to the U.S. Atomic Energy Commission.

Long a member of the Engineering Institute of Canada, Dr. Mackenzie served as its president in 1941. In 1943 he was awarded the Institute's Sir John Kennedy Medal given in "recognition of outstanding merit in the profession. . . ." He holds honorary degrees from Dalhousie University, McGill University, Western University at London (Ontario), Queens University (Kingston), the University of Algiers, and the University of Saskatchewan. France made him Chevalier of the Legion of Honor in 1947. Dr. Mackenzie has presented many papers before scientific and engineering societies in Canada and the United States, and has published more than 25 of them in the organs of the societies.

Harvey Seeley Mudd

Harvey Mudd, a mining engineer and former president of the American Institute of Mining and Metallurgical Engineers, is widely known for both his professional and civic activities. After attending Stanford University for two years, Mr. Mudd entered the Columbia School of Mines from which he was graduated in 1912. His early engineering experience was with his father, who had numerous mining interests.

For many years Mr. Mudd's principal

professional activity has been the development and management of the important copper mines of the Island of Cypress in the Mediterranean. This work, international in scope, has been a constantly expanding activity and has given Mr. Mudd wide experience in foreign business procedures and in personnel management. At times more than 5,000 workers have been employed in the mines, mills, and other facilities involved in the work. He is a director of the Southern Pacific Railroad and a number of other business enterprises.

Mr. Mudd was a director and vice-president of the AIME for many years, and in 1945 served as its president. In 1929, in cooperation with other members of his family, he established the Seeley W. Mudd Memorial Fund, the income of which goes to the Institute for researches, publications, or other projects that will advance the sciences and arts of mining and metallurgy. A number of valuable volumes have already been financed and published by means of this fund.

The breadth of Mr. Mudd's civic interests is attested by such diverse activities as the presidency of the Southern California Symphony Association, and membership on the board of governors of the Los Angeles Museum of History, Science and Art and the Southwest Museum. He has also been a trustee of the California Institute of Technology. In 1936 he was recipient of an annual award given by the City of Los Angeles to the citizen contributing "the most valuable and unselfish service to the community."

Ary Frederico Torres

Widely known as a civil engineer and authority on cement and other construction materials, Ary F. Torres, of Sao Paulo, Brazil, has also been instrumental in the development of many basic South American industries. At present he is Brazilian ambassador to the United States Point 4 Program and president of the National Economic Development Bank of Brazil.

A civil engineering graduate of the University of Sao Paulo in 1923 and of the University of Paris in 1927, Dr. Torres was director of the Institute de Pesquisas Technologicas de Sao Paulo, the biggest technological research organization in South America, from 1926 to 1939, and for a year of this period (1937) served as Secretary of Highways and Public Works for the State of Sao Paulo. He was vice-president of Siderurgica Nac., Volta Redonda, in 1941 and 1942, and executive assistant for the Sector of Industrial Production, Coordination of Economic Mobilization, in 1942 and 1943. At present he is superintendent-director of Cia. Brasileira de Material Ferroviario; director of Cia. Mogiana de Estradas de Ferro; member of the National Board of Industrial and Commercial Policy; member of the Commission of Economic Planning; and professor of materials of construction at the University of Sao Paulo.

Dr. Torres is author of several well-known texts, including *Dosagem dos Concretos* (1927); *Determinacao dos Limites de Elasticidade dos Metais* (1929); *History and Evolution of the Institute de Pesquisas Tecnologicas* (1939); and *Chemical Constitution of Portland Cement* (1942). He is also author of various technical articles, and a member of numerous Brazilian, United States, French, and British technical societies.

ASCE Prizes to Be Awarded at Centennial Convocation

Winners of ASCE prizes and awards for papers appearing in Volume 116 of TRANSACTIONS (1951) were announced by the Board of Direction at its Denver meeting. Presentation will be made at a luncheon at the Conrad Hilton Hotel in Chicago, on Saturday, September 6, during the ASCE Centennial Convocation. Descriptions of the various awards are given in the Official Register for 1952, beginning on page 63. It should be noted that the Construction Engineering Prize differs from the others in being specifically limited to material appearing in CIVIL ENGINEERING.

Highlights in the careers of those receiving prizes and medals follow.

Clarence E. Keefer

An authority in the sanitary engineering field, Clarence E. Keefer, M.ASCE, deputy sewerage engineer for Baltimore, is winner of the Thomas Fitch Rowland Prize for his paper on "Improvements at the Back River Sewage Works, Baltimore, Md." Author of more than 90 articles dealing with sewerage practices or reporting the results of experimental and developmental work at the Baltimore sewage-treatment works, Mr. Keefer was recently appointed an editorial associate of *Water and Sewage Works*. He is also author of a widely known text, *Sewage Treatment Works*, and a contributor to anthologies in the disposal and treatment field.

CLARENCE E. KEEFER
Thomas Fitch Rowland Prize

JOHN M. KYLE
James Laurie Prize

BASIL W. WILSON
Arthur M. Wellington Prize

T. WILLIAM LAMBE
Collingwood Prize for Juniors

HAROLD R. HENRY
J. C. Stevens Award

MARIO G. SALVADORI
Leon S. Moisseiff Award

DONALD J. BLEIFUSS
James W. Rickey Medal

JOHN N. NEWELL
Construction Engineering Prize

Mr. Keefer received a B.S. degree in civil engineering from Johns Hopkins University in 1919 and later did graduate work in chemistry there. During his tenure with the City of Baltimore, which began in 1919, he has also taught sanitary engineering at Johns Hopkins. He is inventor of equipment in wide use in sedimentation units and sludge digestion tanks, and has directed extensive studies of treatment problems at the Back River plant.

The many honors accorded Mr. Keefer include two awards of the Federation of Sewage and Industrial Wastes Associations—the Kenneth Allen Award (1947) and the George B. Gascoigne Medal in 1950. He is a member of numerous scientific and professional societies, for which he has done extensive committee work, and has served the Maryland Section of ASCE as secretary, treasurer and president.

John M. Kyle

The recipient of this year's James Laurie Prize is John M. Kyle, Jr., chief engineer of the Port of New York Authority, who wrote on "Settlement Correction at La Guardia Field." A graduate of Stevens Institute of Technology (1925), where he received a degree in mechanical engineering, Mr. Kyle later did graduate work at Columbia and New York universities. The early part of his career was spent in gaining practical experience in his chosen field of foundation work. In 1932 he joined the George J. Atwell Corp., as engineer, subsequently becoming chief engineer. He worked on such projects as the foundations for Radio City, the Federal Office Building in New York City, the Hendrick Hudson Parkway, the West Side Highway in New York, the New York Plaza of the Queens Midtown Tunnel and the Lincoln Tunnel.

In July 1943 Mr. Kyle enlisted in the Corps of Engineers. While in charge of the Engineer section of the First Engineer Airborne Unit Training Center, he participated in the training of engineer troops for construction of advance air bases, and in 1944 he was assigned to the Air Staff of Commanding General Army Air Forces to perform survey and field evaluation work on all major air-force installations in the United States and throughout the world. In this capacity he travelled 54,000 miles. Upon cessation of hostilities in Europe, he was transferred to the Pacific theater of operations where he continued the survey of installations. For his work on this assignment, he was awarded the Army commendation.

In 1946 Mr. Kyle joined the staff of the Port of New York Authority as assistant chief engineer, and in October 1947 was appointed chief engineer. Under his direction the engineering staff of the Port Authority has supervised the design and construction of $80,000,000 worth of new facilities, including such structures as the Mid-Manhattan Bus Terminal, the West 179th Street Vehicular Tunnel in Manhattan, and three new hangars and other buildings at New York International Airport, and has performed major rehabilitation operations at La Guardia Airport. It is now in the process of completely rebuilding Newark Airport and completing design studies and plans for a third tube of the Lincoln Tunnel.

Basil W. Wilson

Winner of the Arthur M. Wellington Prize is Basil W. Wilson, A. M. ASCE, of Johannesburg, South Africa, who wrote on "Ship Response to Range Action in Harbor Basins." A civil engineering graduate of the University of Cape Town in 1931, Mr. Wilson entered the service of the South African Railways and Harbours at Port Elizabeth Harbour in 1932. The following year he was transferred to the Research Section of the Chief Civil Engineer's Department in Johannesburg, where he was employed for the next 19 years, recently terminating his engagement to do research in the United States.

In 1937 Mr. Wilson was awarded a Commonwealth Fund Service Fellowship for two years' study and research at the University of Illinois, where he received the degree of M.S. in railway engineering in 1939 and the C.E. degree in 1940. Upon his return to South Africa, he continued as principal assistant to the research engineer on investigations of railroad track, mechanics of vehicle motion on curves, metallurgy of rail steels, strength of engineering materials, economics of railway location, and other problems.

During the war he was commissioned to investigate the problem of wave and surge action in Table Bay Harbour, Cape Town, which had become a serious menace to passing ships. The paper for which the present award is made, was based on one phase of these researches. Mr. Wilson recently completed a thesis for the doctor of science degree in engineering on the researches and model studies on range action in Table Bay Harbour.

T. William Lambe

T. William Lambe, J. M., ASCE, winner of the Collingwood Prize for Juniors for a paper on "Capillary Phenomena in Cohesionless Soils," is associate professor of soil mechanics at the Massachusetts Institute of Technology. He holds the degrees of bachelor of civil engineering from North Carolina State College (1942) and master and doctor of science from M.I.T. (1942 and 1948). He was an instructor at the University of New Hampshire in 1942 and 1943; a designer for the Standard Oil Company of California in 1944; and an engineer for Dames & Moore in California in 1944 and 1945. On the M. I. T. staff since 1945, he was promoted to associate professor in 1952. He is a consultant on dams, foundations, and soil stabilization, and since 1951 has

(*Continued on page 84*)

BROOKLYN was "unprintable"

Recently, The Consolidated Edison Company (in New York City) faced this problem: It had to produce a direct-process print from each one of more than ten thousand Brooklyn Underground Record Maps, showing the distribution system of electric service.

But satisfactory prints could not be produced directly from these maps. They were up to 30 years old . . . had been referred to constantly . . . and as a result were soiled, stained, creased, and "dog-eared."

What to do? Retracing was out of the question, since it would take a draftsman from two to three days to trace and check just one of these 17" x 25" drawings.

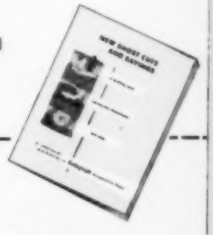
Kodagraph Autopositive Paper was the speedy, economical solution

With this revolutionary photographic intermediate paper, approximately 40 sharp and clean "duplicate originals" could be turned out in an hour. *Yes, 40 in an hour* because Kodagraph Autopositive Paper produces positive copies directly—without a negative step, without darkroom handling. At the same time, it drops out stains, creases . . . cleans up backgrounds . . . transforms weak detail into dense photographic black lines. Furthermore, Autopositive Paper can be exposed in standard print-making equipment . . . and processed in standard photographic solutions.

Thus, Consolidated Edison obtained—*in record time and at minimum cost*—a complete set of duplicate originals, which were used to produce the required direct-process prints . . . and were then filed away for future reference work and print-making needs.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction



Learn in detail all the ways you can save with Kodagraph Autopositive Paper—the revolutionary photographic intermediate material which you, or your local blueprinter, can process *quickly . . . economically . . . at low cost.* Mail coupon today for free booklet!

EASTMAN KODAK COMPANY
Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a copy of "New Short Cuts and Savings"... describing the many savings Kodagraph Autopositive Paper is bringing to industry.

Name_____ Position_____
(please print)

Company_____

Street_____

City_____ Zone_____ State_____

Kodak
TRADE-MARK

"Specs" can't begin to tell the story —we invite you to

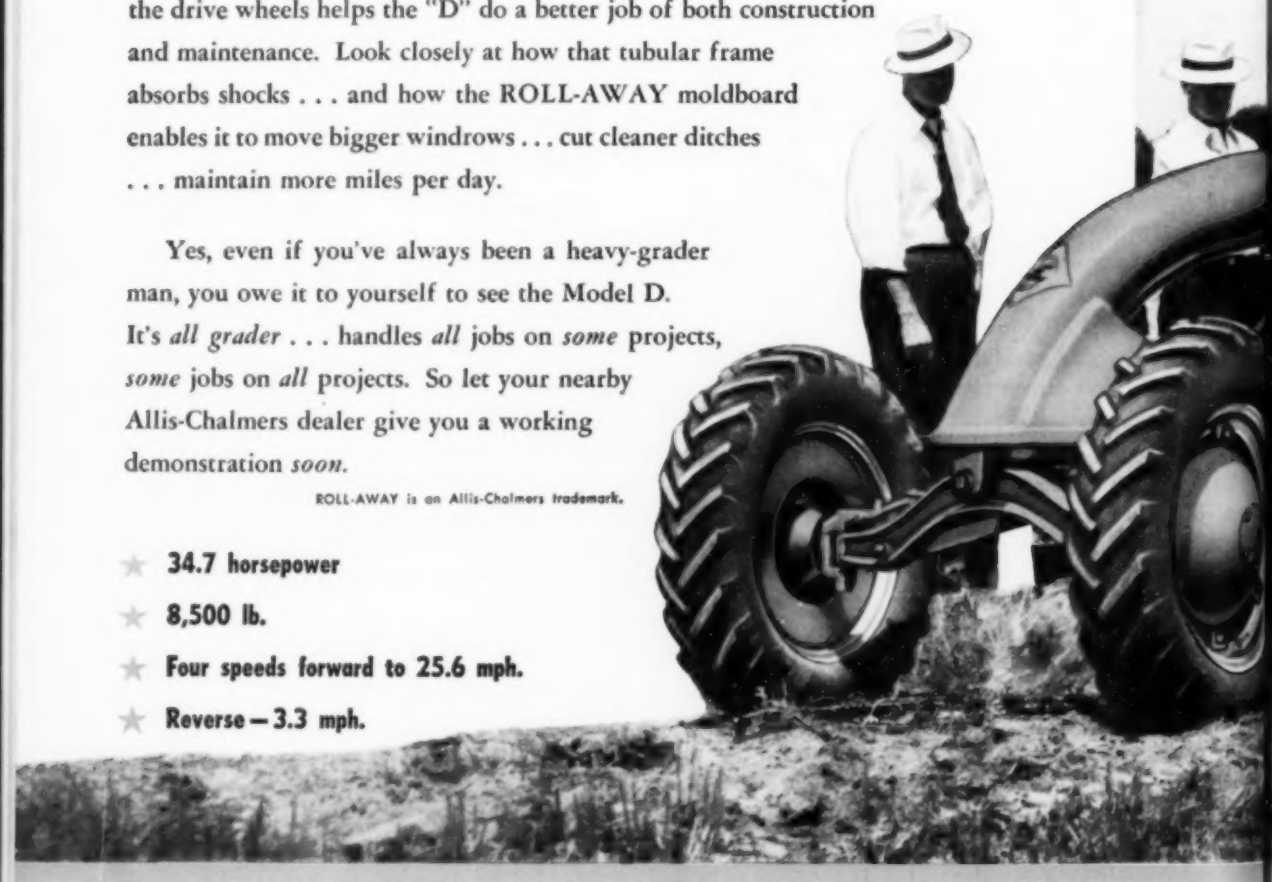
See the model D

Only by watching the Model D *at work* will you believe that a grader costing so little can do so much . . . and that's just what your Allis-Chalmers dealer wants you to do. *See* how tandem drive design with engine over the drive wheels helps the "D" do a better job of both construction and maintenance. Look closely at how that tubular frame absorbs shocks . . . and how the ROLL-AWAY moldboard enables it to move bigger windrows . . . cut cleaner ditches . . . maintain more miles per day.

Yes, even if you've always been a heavy-grader man, you owe it to yourself to see the Model D. It's *all grader* . . . handles *all* jobs on *some* projects, *some* jobs on *all* projects. So let your nearby Allis-Chalmers dealer give you a working demonstration *soon*.

ROLL-AWAY is an Allis-Chalmers trademark.

- **34.7 horsepower**
- **8,500 lb.**
- **Four speeds forward to 25.6 mph.**
- **Reverse — 3.3 mph.**



THE NEWEST, FINEST LINE ON EARTH!

in ACTION!

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

(*Continued from page 80*)

been director of the Soil Stabilization Laboratory at M.I.T.

Dr. Lambe's work in soil stabilization has been described in papers presented before various engineering societies. He is also author of a textbook, *Soil Testing for Engineers*.

Harold R. Henry

Harold R. Henry, J. M. ASCE, research associate in the civil engineering department at Columbia University, is winner of the J. C. Stevens Award for his discussion of the paper, "Diffusion of Submerged Jets." Completing his work for a bachelor degree at the Georgia Institute of Technology in 1947, Mr. Henry taught in the mathematics department of the same institution for a year. In 1948 and 1949 he did graduate work and research in hydraulics at the State University of Iowa, where he was in charge of the Ralston Creek Hydrologic Project. After graduating from Iowa with an M.S. he returned for a year to Georgia Tech as a teacher of hydraulics and as acting director of the hydraulics laboratory.

Now at Columbia University completing his work for a Ph. D., Mr. Henry is engaged in boundary layer research for the Office of Naval Research.

Mario G. Salvadori

An authority in engineering mechanics and applied mathematics, Mario G. Salvadori, A.M. ASCE, associate professor of civil engineering at Columbia University, receives the Leon S. Moisseiff Award for his paper on "Numerical Computations of Buckling Loads by Finite Differences." Professor Salvadori holds doctor's degrees in civil engineering and mathematics from the School of Engineering at the University of Rome, and in 1933 and 1934 was research fellow at University College, London, doing research work in photoelasticity. He was instructor in the theory of structures at the School of Engineering and Architecture at the University of Rome from 1934 to 1938, serving simultaneously as consulting engineer for the Italian National Research Council and as professional engineer and reinforced concrete designer.

Coming to the United States in 1939, Professor Salvadori has been a citizen since 1944. His first work here was as time and motion study engineer for the Lionel Corp., at Irvington, N. J. Since 1940 he has been at Columbia University, in positions ranging from lecturer to associate professor. He created a new sequence of five engineering mathematics courses for the university, and was consultant to the Manhattan (atomic bomb) project.

Professor Salvadori is chairman of the Committee on Mathematical Methods of the ASCE Engineering Mechanics Division, and sponsor on mathematical techniques of the Applied Mechanics Division of ASME. He is currently representing ASCE at the International Congress of Theoretical and Applied Mechanics in Istanbul. He is author of numerous papers on applied mathematics, applied mechanics, and structures in American, British, and Italian publications, and is co-author of two texts—*The Mathematical Solution of Engineering Problems* and *Numerical Methods in Engineering*.

Donald J. Bleifuss

Donald J. Bleifuss, A.M. ASCE, of San Francisco, Calif., is winner of the James W. Rickey Medal for a paper entitled "Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development".

Mr. Bleifuss graduated from the University of Minnesota in 1920, after serving as a captain of field artillery in the first World War. He spent three years in highway work in Minnesota, and since then has been almost continuously engaged in hydroelectric power development. His experience includes sixteen years in the employ of the Aluminum Company of America, and for the past seven years he has been with the International Engineering Company, Inc., of San Francisco, where he is now director of engineering.

John N. Newell

This year the Construction Engineering Prize for a paper in CIVIL ENGINEERING goes to John N. Newell, M. ASCE, of Kansas City, Mo., for his paper in the July 1951 issue entitled "Floating Caissons for Yorktown, Va., Bridge Sunk to 150-Ft Depth in Swift-Flowing Tidal Water."

Mr. Newell received his pre-college education at St. John's Military Academy, Delafield, Wis. and Principia Junior College, St. Louis. He was a member of the Class of 1934 at the United States Military Academy, West Point, N. Y. In following the engineering profession, he worked three years with the Corps of Engineers, U. S. Army, on Missouri River improvement.

Mr. Newell was a partner in a coal-stripping venture in Southwest Missouri in 1937 and 1938. He then became associated with the Massman Construction Co. as field engineer on bridge construction and was actively engaged in the building of several bridges across the Mississippi and Missouri rivers. For the past seven years he has held the position of chief engineer of the Massman Construction Co., general contractors, with home offices located in Kansas City, Mo.

Official First-Day Cover

Approved design for special engraved envelopes or covers for use in first-day mailings of three-cent commemorative stamp honoring one-hundredth anniversary of ASCE is shown here. This design, developed by Fleetwood Cover Service, of Pleasantville, N.Y., symbolically indicates a century of engineered progress. Instructions for ordering first-day covers and other details are given in item in July issue (page 69). Orders should be sent to Fleetwood Service and not to Society headquarters.

More District Councils and Sub-Sections Favored

Following discussion of Society organizational matters with President Carlton S. Proctor and ASCE Vice-Presidents and Directors who have been actively visiting Local Sections during the past year, the Board of Direction at its Denver meeting decided that Society organization would be bettered and all its activities made more effective by more and better District and regional councils. It was also the consensus of the group that ASCE should have more sub-sections or branches of Local Sections than now exist.

Implementing these ideas was left to the four Vice-Presidents working in cooperation with the Directors in their respective Zones. The Directors were particularly charged with the responsibility of exploring the possibility of establishing new sub-sections or branches of Local Sections wherever it appears that the establishment of such groups would be in the interest of the Society.

Information Wanted from Consulting Engineers

All consulting engineer members of ASCE have doubtless obtained and read the new Society Manual No. 29 on Private Engineering Practice. Through the pages of CIVIL ENGINEERING and otherwise the membership has been advised of the efforts made by the national societies of the design professions, including ASCE, to persuade the three military engineering branches of the Defense Department uniformly to adopt procedures in the negotiation and supervision of architect-engineer contracts along truly professional lines. Engineers concerned were greatly encouraged by a letter dated March 31, 1952, from Lt. Gen. Lewis A. Pick, M. ASCE, Chief of Engineers, Army, advising ASCE and other societies of the design professions that the Corps of Engineers, U. S. Army, had instituted procedures in accordance with the recommendations of the societies of the design professions. General Pick's letter and President Proctor's reply were published in CIVIL ENGINEERING for May 1952, p. 68.

Instructions from the respective chiefs of the three engineering branches of the Defense Department, in line with the recommendations of the societies of the design professions, appear to have been fairly effective. In some instances however, members of the ASCE Board of Direction have been advised that these recommendations covering both the procedure of negotiation and the establishment of fees are continuing to be carried out in an unprofessional manner. Some instances reported show unprofessional procedures to the extent that prime construction contractors acting as contracting agents for the Defense Department are openly requesting competitive bidding for consulting engineering services on defense projects.

After intensive discussion of the subject by the Board of Direction at its June meeting in Denver, Colo., the Board requests all consulting engineers who have made or who have been invited to make engineering contracts with any branch of the Defense Department in recent months to report to the Executive Secretary of the Society any proceedings that appear unprofessional or unethical and negotiations with the Army which do not comply with provisions set forth in General Pick's letter. The amount of the fees negotiated for any such contracts is also urgently needed, together with duration of each contract and the estimated construction cost of the project so that compilations can be made covering the subject of fees as they are actually being negotiated.

The Board of Direction also wishes to call to the attention of all concerned the provision in the Society's Code of Ethics which makes any member who participates in competitive bidding for engineering services on a price basis subject to dismissal from the Society. This provision of the ASCE Code applies equally to engineers who request such competition and those who offer their services on such basis.

Tellers Canvass Ballot for 1953 ASCE Officers

July 1, 1952

To the Secretary
American Society of Civil Engineers:

The Tellers appointed to count the Ballot for Official Nominees report as follows:

For Vice-President—Zone II
(Term October 1952–October 1954)

Edmund Friedman	375
* N. W. Dougherty	67
Scattering	329
† Ineligible Candidate	10
Void	6
Blank	6
Total	793

For Vice-President—Zone III
(Term October 1952–October 1954)

Charles H. Mottier	325
G. Brooks Earnest	243
Scattering	1,056
† Ineligible Candidate	16
Void	10
Blank	71
Total	1,721

For Director—District 1
(Term October 1952–October 1955)

Charles B. Molineaux	171
Scattering	92
† Ineligible Candidate	99
Void	0
Blank	10
Total	372

For Director—District 3
(Term January 1953–October 1955)

A. A. K. Booth	87
Scattering	33
† Ineligible Candidate	16
Void	0
Blank	0
Total	136

For Director—District 5
(Term January 1953–October 1955)

Carl G. Paulsen	56
* C. Dwight Curtiss	10
Scattering	46
† Ineligible Candidate	10
Void	3
Blank	1
Total	126

For Director—District 7
(Term January 1953–October 1955)

Lloyd D. Knapp	273
Scattering	15
† Ineligible Candidate	8
Void	0
Blank	4
Total	300

For Director—District 9
(Term January 1953–October 1954)

Warren Wright Parks	166
Don Melvin Corbett	123
Scattering	117
† Ineligible Candidate	0
Void	5
Blank	6
Total	417

For Director—District 11
(Term October 1952–October 1955)

M. J. Shelton	558
Scattering	166
† Ineligible Candidate	154
Void	3
Blank	3
Total	884

For Director—District 12
(Term January 1953–October 1955)

Glenn W. Holcomb	308
* Edward C. Dohm	150
Scattering	32
† Ineligible Candidate	0
Void	1
Blank	0
Total	491

For Director—District 16
(Term January 1953–October 1955)

Earl L. Mosley	333
Francis M. Dawson	281
Scattering	13
† Ineligible Candidate	4
Void	1
Blank	2
Total	634

Total number of ballots counted	5,874
Ballot envelopes without signature	14

Respectfully submitted

PAUL M. WENTWORTH,
Chairman,

ROBERT E. WHITE,
Acting Vice-Chairman

Gordon Bronson	Edward S. Jarosz
Alex J. Castro	Arthur J. Klag
Simeon Chanley	Arthur R. Luecker
Burr L. Chase, Jr.	Frederick J. O'Leary
Warren G. Cummings	Milton C. Shedd
Egidio O. DiGenova	Robert Warshaw

(Tellers)

* Withdrawn.
† These votes were cast for incumbent officers who are presently ineligible for reelection in accordance with Section 9, Article VI, of the Constitution.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

The 82nd Congress adjourned on July 7, completing much important legislation in its last week but failing to pass several bills in which the profession had some interest.

Legislation

As indicated last month, an amendment to the Defense Production Act exempts "professional engineers employed in a professional capacity" from salary controls. Architects employed in a professional capacity are also exempt when employed by a firm of architects. The new exemption will permit some necessary salary adjustments to be made to underpaid engineers. ASCE, EJC, NSPE and AIA participated actively in advising the Congressional committee in regard to the exemption, contained in "The Defense Production Act Amendments of 1952," P. L. 429.

Immediately after approval of this law, the Salary Stabilization Board issued Interpretation No. 12 defining the scope of the amendment and cautioning employers regarding its limitations. In the interpretation the terms "professional engineer" and "employed in a professional capacity" are defined. Employers are cautioned that "the exemption of engineers is not a key to unlock stabilization to permit a free flow of increases for all categories of employees." The Board points out that the permitted raise in salary of a professional engineer cannot be made the basis for increases to other employees to retain historical relationships in salaries between them.

The Federal Highway Act of 1952, P. L. 413, approved June 25, authorized appropriations of $550 million for each of the fiscal years ending June 1954 and June 1955. In addition to the federal-aid primary and secondary highway systems, provision is made for urban highways, forest and park roads, the Baltimore-Washington Parkway, the Pan-American Highway and a road in Nicaragua. Highway engineers and others interested in road development are generally pleased with this legislation.

Public Law 448 authorizes research for studying problems relating to the conversion of salt water into fresh water.

An attempt was made in committee in considering the appropriations for the Bureau of Reclamation to reduce the $100 per day maximum for consultants to $50. As finally passed, the provision for a $100 a day maximum fee for consultants was retained. However, a rather low limit was placed on the total amount available for consulting services. ASCE contacted the Senate Appropriations Committee concerning these matters.

A bill in which Engineers Joint Council was interested (H.J.Res. 218) would have provided for research into the cause, hazards and effects of air pollution, into the methods for its prevention and control, and for recovery of critical materials from atmospheric contaminants. This bill was reported out of committee but failed to come to a vote in the House.

No action was taken on the Individual Retirement Bill and similar proposals (H.R. 4371, H.R. 1173, etc.) Engineers Joint Council had presented testimony on this bill.

Although the bill to correct the situation resulting from the decision in the "Wunderlich Case" passed the Senate, it failed to get on the House calendar in the rush for adjournment. ("From the Nation's Capital," July issue).

The Federal Construction Contract Bill, S. 2907, which would have required the naming of subcontractors in bids on federal construction and the award of separate contracts for mechanical specialty contractors in certain cases, was killed in committee. AGC vigorously opposed this bill.

H.R. 4323 (S. 2137) would have given the government authority to enter into lease-purchase contracts, under which rents paid by the government would apply on the purchase of the property. The structures would be designed according to Public Buildings Services standards. This measure passed the House but failed to emerge from the Senate committee.

Civil Defense and Point IV appropriations were cut very sharply from the amounts proposed by the administration.

Bills authorizing construction of the St. Lawrence Seaway and the Hell's Canyon Dam on the Snake River failed to emerge from committee.

ASCE MEMBERSHIP AS OF July 9, 1952

Members	8,157
Associate Members	10,377
Junior Members	16,281
Affiliates	69
Honorary Members	37
Total	34,921
(July 9, 1951	32,569)

Construction Activity

According to reports from the Labor and Commerce Departments, oil pipe lines and public utilities are expected to show healthy increases for 1952. Atomic energy and defense plant construction will represent outlays of 1.6 billion, a rise of 70 percent over 1951. Military installations may be up to 1.9 billion, an 85 percent increase; school and highway construction will be up. Most other types of public works and public building construction will decline.

A long-drawn-out steel strike* could cut the total but the loss in construction would be less than the loss in mill production of steel.

According to the DPA Administrator, the steel strike caused a loss of over 11 million ingot tons up to July 1 and has thus wiped out for 1952 the benefits of the new plant-expansion program. Steel for 1952 will be at least 6 million tons less than for last year instead of the expected 15 million tons greater.

The succeeding year of 1953 may show a decline from 1952. Generally speaking, government construction analysts are optimistic on the outlook for the next eight years, predicting a possible rise in annual construction volume to $40 billion by 1960. The general economic factors are considered favorable and the shortage of construction caused by NPA controls will be overcome. Commercial construction supply has been below the demand for a decade. A new era of improved highway construction seems to be dawning.

The Department of Defense reports that in the first 11 months of the fiscal year 1952 it obligated $2.1 billion for construction, with $3.7 still available for obligation. During the 23-month period since the attack on Korea, $3.9 billion has been obligated out of a total of $7.6 available for construction.

Washington Office to Close for Vacation

The ASCE Washington office will be closed from the middle of August until September 3.

Washington, D.C.
July 10, 1952

* *Editor's Note:* The steel strike was settled on July 24 after 53 days. The basis for settlement is a 16-cent increase in pay and a modified union shop, with a rise of $5.20 per ton in the price of steel. The breakdown on the steel price ceiling increase is as follows: $2.84 a ton under the Capehart Amendment to the Economic Controls Act which allows boosts to cover cost increases up to last July 26; 70 cents to cover a freight-rate increase of last May 2; and $1.66 to apply to the agreed wage increase. This is the increase for common carbon steel. Alloy and special steels cost more and get more of a rise, making the over-all average rise above $5.64.

Civil Engineer Receives Hoover Medal for 1952

Award of the Hoover Medal for 1952 to Clarence D. Howe, M. ASCE, Canadian Minister of Trade and Commerce and Defense Production, is announced by the award board representing the Four Founder Societies. The accompanying citation reads, "To one of the world's great men, an engineer of vision, energy and decision with ability to get things done. His work has been a boon to his adopted country, to the country of his birth and to mankind."

C. D. Howe

Born in Waltham, Mass., Mr. Howe was educated at Massachusetts Institute of Technology and taught there briefly before going to Canada to teach and work. In 1916 he established his own engineering firm, C. D. Howe, Co., Ltd., in Port Arthur, Ontario, which is widely known for its design of grain elevators and terminals, bridges, docks, factories, flour mills, and industrial buildings. The first professional engineer ever named to the Canadian Cabinet, Mr. Howe received two portfolios—Ministry of Railways and Canals and Ministry of Marine—which he combined for greater efficiency into a Ministry of Transport. He founded Trans-Canada Airlines for the government, which has grown from a 122-mile route to one of the top ten international airlines. As wartime Minister of Production, he expanded the country's infant war industry into a highly potent production force and he has been equally instrumental in the post-war development of the Dominion.

Presentation of the medal to Mr. Howe will be a feature of the Centennial Day luncheon, Wednesday, September 10, during the ASCE Centennial Convocation. He is the fourteenth engineer to receive the medal since it was first awarded to Herbert Hoover in 1930 to commemorate his civic and humanitarian achievements.

J. Waldo Smith Prize Awarded for 1952-1953

Award of the J. Waldo Smith Hydraulic Fellowship is made to James R. Barton who will do research work at the Colorado A & M College during the 1952–1953 school year, with the objective of determining shear distribution in open channels.

Established by the ASCE Board of Direction in 1938, the J. Waldo Smith Fellowship was endowed by a bequest to the Society of the late J. Waldo Smith, Hon. M. ASCE. The fellowship, which currently carries a cash award of $1,000 plus an allowance of $400 for equipment, emphasizes practical research in the field of experimental hydraulics rather than purely theoretical hydraulics.

New Daniel Mead Prize Subject Is Announced

A new contest for the Daniel W. Mead Prizes for papers on some phase of professional ethics is announced by the Committee on Professional Conduct. In the 1953 contest both Junior Members and members of ASCE Student Chapters will write on the same subject, "Under what circumstances and to what extent should duration of service constitute professional obligation?" All papers intended for entry in the competition should be in the hands of the Executive Secretary of ASCE not later than June 1, 1953.

Established and endowed in 1939 by the late Daniel W. Mead, Past-President and Honorary Member of ASCE, the prizes consist of a Junior Member award of $50 in cash and a certificate, and a student prize of $25 in cash with a certificate.

Collaboration with German Soil Engineers Arranged

Arrangements for collaboration of the German Soil Engineering Society (Deutsche Gesellschaft für Erd-und Grundbau) with the ASCE Soil Mechanics and Foundations Division are reported by Gregory P. Tschebotarioff, M. ASCE, chairman of the Division's Committee on Collaboration with Foreign Engineering Societies. The collaboration will be handled at the American end through the Committee on Collaboration. As a first step in the program, it is proposed to facilitate the development of individual direct contacts between German and American soil engineers who happen to be working in the same branch of the field, with the objective of exchanging information on soil engineering work published during and immediately after the war as well as on current soil engineering developments.

Engineers wishing to avail themselves of this opportunity may notify the Society of the specific problem on which they desire information. Requests will then be forwarded to the representative of the other society for answer. Correspondence will be conducted in the language of the country of origin—that is, in German from Germany and in English from the United States.

Inquiries may be directed to Professor Gregory P. Tschebotarioff professor of civil engineering at Princeton University, Princeton, N.J.

Members of Los Angeles Junior Forum, which plays prominent part in Society activities in Los Angeles area, sponsor annual spring banquet in Montebello, Calif. Pictured at head table are (left to right) John B. Howe, president, Executive Council, Los Angeles Junior Forum; R. C. Gerke, secretary-treasurer, Executive Council, Junior Forum; D. E. Carroll, vice-president, Executive Council; Marshall Pond, banquet chairman; Judge LeRoy Dawson, speaker of evening, who discussed "What I Like About America"; Philip Abrams, chairman of local arrangements for banquet; John Q. Jewett, senior contact member on Executive Council; and Thomas Waters, past-president, Executive Council. Roy Anderson, president of Los Angeles Section, is seated second from end in row nearest camera.

Coming Events

Duluth—Meetings are held the third Monday of every month at the Kitchi-Gammi Club in Duluth.

Nebraska—Meeting on September 10 in Omaha, Nebr.

Sacramento—Weekly luncheons every Tuesday at the Elks Temple, Sacramento, at 12 noon.

San Francisco—Weekly luncheons every Tuesday at the Engineers' Club of San Francisco.

INTER-AMERICAN CONVENTION
San Juan, Puerto Rico, November 12–15 1952

Scheduled ASCE Conventions

CENTENNIAL CONVOCATION
Conrad Hilton Hotel
Chicago, Ill., September 3–13, 1952

SAN FRANCISCO CONVENTION
San Francisco, Calif., March 2–7, 1953

MIAMI BEACH CONVENTION
June 17–19, 1953

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Alaska			
Anchorage Subsection	May 21	64	Dinner dance. Col. Louis E. Foote who will succeed Col. L. E. Seeman as Alaska District Engineer, was guest of honor.
	June 17	156	Joint meeting with Society of American Military Engineers at Eklutna project of the USBR. Tour and description of project were features of meeting.
Fairbanks Subsection	June 10	26	Almon H. Fuller, professor of civil engineering, Iowa State University, addressed the meeting on the subject of the engineering profession.
Buffalo	June 17	49	Luncheon. William P. Creager, consulting engineer; Newell L. Nussbaumer, Nussbaumer & Clark; and Howard F. Stimm, H. F. Stimm, Inc.; reviewed highlights of engineering achievment in their fields.
Central Illinois	June 5	32	Dinner meeting. Student awards presented to Lawrence D. Humbard, Ronald A. Maina, and James P. Roberts. ASCE President Carlton S. Proctor gave a talk on the Centennial of Engineering.
Kansas	May 16	70	Joint meeting with Student Chapters from Kansas University and Kansas State College. Junior membership awards to Ted Taylor, Kansas University and Blaine R. Englund, Kansas State College.
Maine	May 21	45	Francis Carboine of the Civil Aeronautics Authority was the principal speaker.
Mid-South			
Jackson Branch	May 20	18	Dinner meeting. Emile B. Cavallo of Cavallo & Wier, Engineers, Jackson, Miss., led a discussion on Jackson's traffic problems.
	June 17	18	Two films, "America's First Prestressed Concrete Highway Bridge" and "Prestressed Concrete Railway Tressle Slab" were shown by John P. Bunnell, of the Portland Cement Association.
Sacramento	May 6	95	An illustrated talk on urban bypasses was given by J. C. Young, traffic engineer for the California State Division of Highways.
	May 27	64	Student Award was presented to Carleton E. Forbes of the University of Nevada. Donald Bolton of the California State Bridge Department gave a talk on "Engineers and Unions or Associations."

Playing important part in success of recent two-day spring meeting of Mid-South Section, held at Vicksburg, Miss., are (left to right) K. W. Lefever, Little Rock, Ark., president of Mid-South Section; T. J. Buntin, Vicksburg, chairman, Registration Committee; E. H. Eckler, Vicksburg, chairman, Program Committee; F. R. Brown, Vicksburg, general chairman; F. S. Hill, chairman, Reception Committee; R. A. Harris, chief engineer, Mississippi State Highway Department, Jackson, Miss.; Harry Rubey, chairman, Civil Engineering Department, University of Missouri; and

G. B. Davis, Vicksburg, member of Program Committee. Max Foresman, public relations manager of Spencer Chemical Co., addressed large joint luncheon on need for unity in the profession. During Section business meeting it was decided to provide $150 to assist Student Chapter members in attending ASCE Conventions and regional conferences, and to revise Section bylaws to provide for continuing financial support of Student Chapters. Attendance was about 150.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

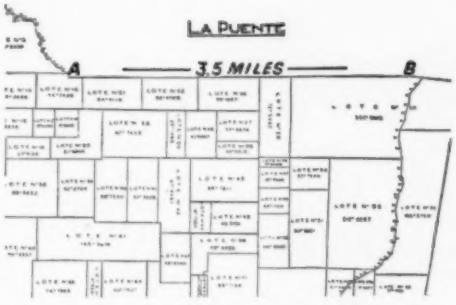
Mexican Jigsaw Puzzle

"Have you ever subdivided 50,000 acres into nearly 200 lots in accordance with rights of 600 people?" asks George S. Salter of the Bureau of Engineering, Chicago's Department of Public Works. "That was only one problem on an assignment down in Mexico 20 years ago.

"The Hacienda of Tanceme, about 60 miles south of Tampico in the state of Vera Cruz, was leased by an oil company with the provision that it be subdivided into lots corresponding to rights of the various owners. These rights, or *derechos,* had been passed down, generation to generation, from holders of the original Spanish land grant, issued around 1800 and delimited by metes and bounds.

"The persons holding rights belonged to about 200 families, so it was agreed to divide the area so as to give each family a lot. This led to quite a complicated puzzle, since each insisted on land where his house or pasture was already located.

George S. Salter, in Mexico, found "my mule as reliable as my Gurley for rough conditions."



Section of map of Hacienda of Tanceme, showing final line of disputed boundary with La Puente.

Settling a Boundary Dispute

"The limits of the hacienda were set by a survey requiring four parties and five months' work, and the area was subdivided. Some heirs could not be found, so one lot was assigned to *desconocidos,* the unknown ones. Then owners of three adjoining haciendas claimed that incorrect boundaries had been used. My job was to straighten them out.

"This involved considerable resurvey work, not to mention patience and diplomacy. We were aided by older men—*los conocedores,* the knowing ones—from each hacienda, who were to agree on dividing lines.

"One hotly-contested boundary was with La Puente to the north. Its people contended that a crucial point in the grant was further south than we had it in our original survey. A new point ('B' on map) was finally agreed on, and a 3.5-mile boundary west to an irregular line had to be re-established.

"This was all brush country; so a *brecha,* a cleared line about 1 meter wide, was cut through to connect 'B' with the original line. We computed the closing in the field; and a new line was cut from 'B' to a new point, 'A.' Believe it or not, using my Gurley Hell Gate 20-second transit, I hit the point within the width of the *brecha.*"

We'd like your story for a future page in this series. Drop us a line...we'll contact you for details later. Ask for Bulletin 50 giving complete data on Gurley instruments.

©1952 W. & L. E. GURLEY

W. & L. E. GURLEY, 518 FULTON STREET, TROY, N. Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments.

GURLEY

Surveying and Scientific Instrument Makers

Since 1845

NEWS BRIEFS . . .

Architect-Engineer Cooperation Is Urged at 84th Convention of AIA

Celebration of the "Re-Union of Engineering and Architecture" was a dominant feature of the 84th annual convention of the American Institute of Architects, held at the Waldorf-Astoria in New York during the week beginning June 23. Speakers stressing the theme, especially developed to honor the ASCE Centennial celebration, included talks by Glenn Stanton, president of the AIA, and ASCE President Carlton S. Proctor.

An important part of the commemorative ceremonies consisted of the presentation of an honorary membership in AIA to ASCE member, John P. Riley, New York City Coordinator of School Construction. As another phase of the program, the AIA had arranged a large exhibit of photographs illustrating architectural and engineering progress in the lobby of the newly opened Lever House, where the commemorative ceremonies were held before an audience of 800. The program was along the lines of cooperative action and improved relationships being suggested by the recently established Joint Cooperative Committee of ASCE and AIA.

The technical program also stressed the need for closer cooperation between architects, engineers, and the building industry, with talks by such engineers as Mr. Riley; Roger Corbetta, president of the Corbetta Construction Co.; C. S. Whitney, M. ASCE, of the New York and Milwaukee firm of Ammann & Whitney; M. J. Holley, Jr., A.M. ASCE, associate professor of structural engineering at Massachusetts Institute of Technology; Fred Severud, M. ASCE, partner in the New York structural firm of Severud, Elstad & Krueger; and Pyke Johnson, president of the Automotive Safety Foundation.

Better peacetime living as well as security against the threat of atomic attack was promised in a program recommended by the AIA. A resolution adopted by the membership at its first business meeting called for emphasis on decentralization and dispersal of cities and industries, and a radical replanning of the central areas of existing cities to relieve congestion and provide better conditions for work and living. The resolution called attention to the federal redevelopment program as providing "the only prospect for stabilizing and rejuvenating the centers of our older cities," and advocated strengthening the federal highway program to include urban parkways for relief of urban congestion, and to provide park and playground strips, firebreaks, and free circulation for national defense.

In another resolution, the group took exception to the reported practice of the Public Buildings Service of the General Services Administration in encroaching upon the work of private architects by performing detailed building design with government employees, and asked government officials to confer with them in order to set up procedures for preventing such "extension of government functions into the area of private practice."

Mr. Stanton, who was reelected to the presidency of the AIA, is a practicing architect in Portland, Oreg.

AIA President Glenn Stanton (right in both photos) introduces John P. Riley, M. ASCE, to AIA gathering in Lever House to celebrate "Re-Union of Engineering and Architecture" during recent 84th annual convention of AIA. Mr. Riley (lower left) was awarded honorary membership in AIA. In upper photo Mr. Stanton is shown with ASCE President Carlton S. Proctor.

New Mississippi Bridge at New Orleans Studied

The feasibility of a new bridge over the Mississippi River at New Orleans is under study by the New York consulting firm of D. B. Steinman, M. ASCE. The Board of Commissioners of the Port of New Orleans has authorized studies and a report on the practicability and approximate cost of a four-lane suspension structure. Studies and estimates are required for alternate designs with main spans of 1,800 and 2,000 ft, respectively, and with vertical clearances of 135 and 150 ft.

An examination of the famous Covington-Cincinnati suspension bridge over the Ohio River, built by John A. Roebling, M. ASCE, is being made by the same firm, with a view to preparing recommendations for modernization. With a record span of 1,057 ft, the bridge was considered the greatest in the world at the time of its completion in 1867.

Los Angeles Water District Awards Pump Contract

Contracts for ten large pumps to bring more Colorado River water into Southern California have been authorized by the Metropolitan Water District of Southern California, according to an announcement from Warren W. Butler, vice-chairman of the district. The contracts totaling $1,548,620 have been awarded to the Worthington Corp. and the Byron Jackson Co., each of which will supply four, and the Allis-Chalmers Co., which will supply two.

Although the Metropolitan Aqueduct tunnels were initially built to ultimate capacity, only three pumps were originally installed in each of the five main pumping stations along the route of the 457-mile aqueduct serving Los Angeles and other cities. Two additional pumps, each with a capacity of 90,000 gpm, will be installed in each plant. Full capacity of each plant is nine pumps. The new units will be driven by synchronous motors costing $2,811,200, for which contracts have already been awarded. The motors will be operated by electric power from Hoover and Parker dams.

When the new pumps are in service, the Colorado River aqueduct will be able to deliver up to 650 mgd of Colorado River water to the area served by the Metropolitan Water District, according to Robert B. Diemer, M. ASCE, chief engineer and general manager. Its ultimate capacity is 1 billion gallons daily.

Asks U. S. Leadership In Developing Standards

Calling on American industry and the professions to take a position of stronger leadership in the development of international engineering, industrial, commercial, and safety standards, Roger E. Gay, president of the American Standards Association, told 350 foreign and American delegates attending the recent second General Assembly banquet of the International Organization for Standardization that the lack of such leadership is costing the country good will. The banquet preceded two days of plenary sessions of the 33-nation ISO general assembly at Columbia University, June 20 and 21.

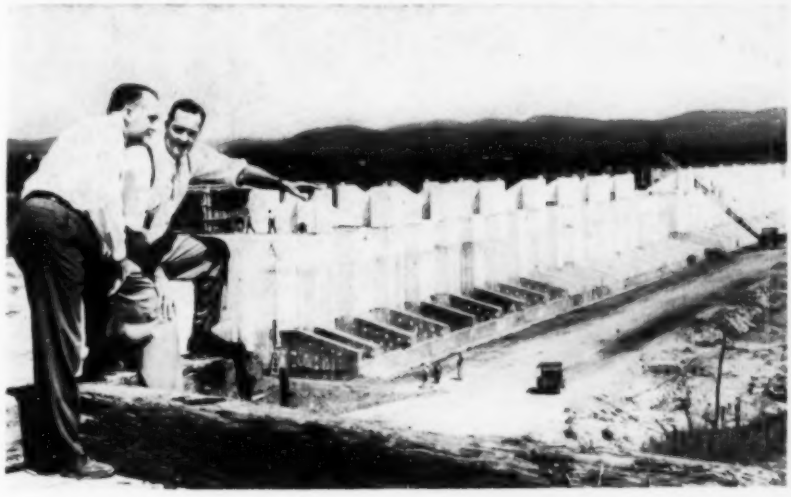
Mr. Gay stated that American industry is participating in the work of only 23 of the 76 ISO technical committees that are working on international standardization projects, despite their "potentialities for improving quality, increasing production, lowering costs and prices and broadening markets to provide more goods for more people at less cost throughout the world."

Dr. Albert Caquot, French scientist who will retire at the end of the year as president of the ISO, called for a union of technicians "that will be a prelude to and the means of achieving union among the people of the world."

In a letter of greeting read to the group, President Truman noted that, "Standardization is enabling buyers and sellers in different nations to speak the same language. In the field of scientific and technological research, international standardization is important in connection with documentation and the adoption of uniform terms, definitions, symbols and testing methods."

It was brought out in the addresses that in its five years of active work the ISO has approved or is about to approve eleven international standards. Development of standards in such fields as screw threads and couplings is being studied by 76 ISO technical committees and 40 subcommittees.

Concrete Box Substructure for Pier 57 Nears Completion



Three huge, pontoon-type concrete boxes for Hudson River pier, designed to replace Pier 57 on Manhattan waterfront, are being prepared for trip down the Hudson in pumped-out lake bed along river near Grassy Point, N. Y., where they have been under construction during past year. In foreground are Edward F. Cavanagh, Jr., commissioner of Department of Marine and Aviation, and William Denny, vice-president of Merritt-Chapman & Scott Corp., one of contractors on project, just before turning of valve to flood lake bed with Hudson River water. With rising of water and good weather and tide conditions, the boxes will be floated out into river, one by one, for 30-mile trip downstream to pier construction site at Fifteenth Street in Manhattan. Total weight of three boxes is estimated at 71,000 tons. When finally in place, their buoyancy will support 80 percent of weight of pier. Merritt-Chapman & Scott and the Corbetta Construction Co. hold joint $5,685,491 low-bid contract for construction of substructure and deck. Engineers on project are New York firm of Madigan-Hyland. Design by Emil H. Praeger, M. ASCE, chief engineer for Madigan-Hyland.

Role of Engineers In AEC Held Vital

The role of engineers, and particularly of civil engineers, in atomic energy work was underscored at the recent Pacific Northwest Conference of ASCE Local Sections (June issue). The speaker, David F. Shaw, manager of the Hanford Operations Office of the Atomic Energy Commission, stated that "The atomic energy business is one in which professional engineers play a particularly important part."

To illustrate his point, Mr. Shaw cited the following statistics, which were approximately accurate as of September 30, 1951. Of an approximate total of 59,664 employees including the 51,931 contractors who are operating the research and production facilities of the AEC, there were 395 professional engineers, of whom 150 were civil engineers. Among the 6,820 contractors who were professional engineers, there were 1,400 civil engineers. Of a total of 9,226 employees, including 8,896 contractors, at the Hanford plant, there were 85 professional engineers, of whom 34 were civil engineers. Among the 769 contractors who were professional engineers, there were 104 civil engineers.

Mr. Shaw further noted that civil engineers seem to have a particular propensity for getting into lines of work other than straight technical engineering. Of the total of 138 civil engineers (plus 30 more on construction contractors' staffs) at the Hanford Works, for instance, between one third and one half are in jobs that are classified as managerial, administrative, and production, rather than as technical and engineering.

Virginia Passes Turnpike Enabling Legislation

Recent laws passed by the Virginia General Assembly give the State Highway Commission the authority to construct toll turnpikes and the right to issue revenue bonds for their construction. Previously special laws have authorized the road agency to construct toll bridges, but there has been no law permitting construction of toll roads.

Cities and towns will benefit by an amendment permitting them to use state funds previously reserved for maintenance to pay debts incurred for street construction. Another law makes the chief engineer of the State Highway Department "deputy commissioner" so that he may act for the commissioner in his absence or when delegated to do so.

Navy Expands Fuel Depot Facilities at Newport

Recent award to the Merritt-Chapman & Scott Corporation, of New York, of a $1,195,714 low-bid contract for construction of aviation gas and jet fuel storage and distribution facilities at the Melville Fuel Facility, U.S. Naval Supply Depot, at Newport, R.I., is announced by the Office of the First Naval District. The major phases of the work entail construction of facilities to run fuel from the docks to underground tanks by means of a booster pumphouse and two miles of underground transmission lines.

ASTM Celebrates Its Fiftieth Anniversary

The program at the 50th anniversary meeting of the American Society for Testing Materials, held at the Hotels Statler and New Yorker in New York City throughout the entire week beginning June 23, featured 165 papers presented in some forty technical sessions and 70 technical committee reports. The unusually strong technical program, arranged to commemorate the Society's formal incorporation as a national technical society in 1902, together with 450 technical committee meetings and a large exhibit of testing apparatus and scientific instruments, attracted a record attendance of 2,506.

A wide range of subjects related to the behavior of engineering materials was discussed in the technical sessions, with special emphasis on the durability of materials. Herbert K. Cook, chief of the Concrete Research Division of the U.S. Waterways Experiment Station at Jackson, Miss., reported the results of exposure tests on 2,500 concrete specimens in Maine and Florida, in a series on the durability of concrete. Other papers in the series, based on a study of aggregates, were presented by C. A. Vollick and E. I. Skillman, of the Bureau of Reclamation. Masonry problems were explored by F. O. Anderegg, consulting specialist on building materials research, Somerville, N. J., and J. W. McBurney, technologist for the National Bureau of Standards, Washington, D. C. Mr. McBurney showed that cracking in masonry can be traced to free magnesium oxide causing expansion of hardened mortar.

On committee recommendation, 75 new specifications and tests were approved for publication for the first time. Most of the committees have been concentrating this year on revising their standards to bring them up to date for the 1952 edition of a large standards compendium and in reviewing tentatives. Some 90 existing tentatives were recommended for adoption as formal standards subject to society letter ballot. Consideration was also given a request from the Office of Defense Mobilization for modification of Specification A7 for structural steel, with a view to making it more acceptable for use in welded buildings at little or no increase in cost. Two technical committees are celebrating their 50th anniversary this year—Committee C-1 on Cement and Committee D-1 on Paint, Varnish, Lacquer and Related Products.

H. L. Maxwell, supervisor of mechanical engineering consultants for E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., was elected new president of the organization, and N. L. Mochel, manager of metallurgical engineering for the Westinghouse Electric Corp., Philadelphia, vice-president.

Recipients of 1952 ASTM Awards of Merit include H. S. Mattimore, engineering consultant of Colonial Park, Pa., and Douglas E. Parsons, chief of the Building Technology Division, National Bureau of Standards, Washington, D. C. Both are members of ASCE. Medalists include H. F. Gonnerman, M. ASCE, and William Lerch, both of the Portland Cement Association, for a paper on changes in portland cement characteristics.

Night Work Speeds Construction of AEC Paducah Plant

Magnitude of Atomic Energy Commission's $350,000,000 plant under construction at Paducah, Ky., can be realized from this night view taken during round-the-clock construction operations. Some 22,000 persons are currently employed on project, which is now about 50 percent complete. F. H. McGraw & Co., of Hartford, Conn., is sole contractor under fixed-fee contract.

Suspension Bridge to Span Halifax Harbor

Construction of a new suspension bridge across Halifax Harbor between Halifax and Dartmouth will get under way soon, with the award of a contract for fabrication and erection of the superstructure to the Dominion Bridge Co. The second longest bridge in Canada, the structure will have a total length of 4,420 ft, with a main span between towers of 1,447 ft. The height of the towers will be 309 ft, and the main-span clearance 165 ft. Completion of the entire $8,000,000 project, which is being built for the Halifax-Dartmouth Road Commission, is scheduled for 1954.

P. L. Pratley, M. ASCE, of Montreal, is consulting engineer on the project, with C. A. Fowler & Co., of Halifax, associate engineers.

Army Recommends Four Dams in Pennsylvania

Field offices of the Army Corps of Engineers have recommended the construction in Pennsylvania of four dam and reservoir projects for flood control and other beneficial uses at a total federal cost of $75,000,000, according to an announcement from the Department of the Army. The proposed projects would be located on the West Branch of the Susquehanna River and its tributaries—Kettle Creek, Bald Eagle Creek, and Sinnemahoning Creek. The reservoirs would have sufficient flood-storage capacity to control the run-off from drainage areas above the dam sites, with substantial reduction in flood stages in the West Branch Basin below the dam sites and on the Lower Susquehanna River.

The proposed projects will now go to the Board of Engineers for Rivers and Harbors for review.

Work Proceeds on New Missouri Power Plant

Foundations are nearly completed and structural work has been started on the Central Electric Power Cooperative at Chamois, Mo., according to an announcement from the Kuljian Corp., of Philadelphia, engineers on the $3,500,000 project. The initial installation consists of one boiler of 175,000-lb per hr steam capacity at 850 psi and 900 deg Fahr total temperature. This outdoor coal-fired unit will deliver steam to one 15,000-kw, four bleed extraction, hydrogen-cooled turbine. Ultimate station capacity will be four of such 15,000-kw units. The project is being financed by a loan from the Rural Electrification Administration in Washington, D.C.

New York Firm to Build Cleveland Airport Hangar

Construction of a new $3,500,000 hangar at Hopkins Airport, Cleveland, without burden to the taxpayers, is being undertaken by the Thompson-Starrett Company, Inc., New York building firm. Under the plan, which has been approved by the Cleveland City Council, the firm will rent from the city the land required for the hangar and related facilities, will coordinate the design, financing, and construction of the project, and then lease them back to the city on a 25-year lease with the title to revert to the city at the end of the period. Outcalt, Guenther & Associates, architects on the multi-million-dollar Airport Terminal Project, will also be retained as architectural consultants on the hangar project to assure architectural harmony between the two facilities.

Designed to accommodate the largest transport aircraft in use, the new facilities will occupy a 15-acre site. The hangar will have a total length of 750 ft, a depth of 150 ft, a clear height of up to 40 ft, and clear spans of up to 250 ft.

Venezuela Constructs Spectacular Superhighway

First of three nearly identical 500-ft arched bridges is being built here as one phase in construction of ten-mile, four-lane toll highway that is being pushed to completion by Venezuelan government between seaport of La Guaira and capital city of Caracas. Built at estimated cost of $70,000,000 and called "Autopista," project will eliminate 300 hairpin curves on old route and reduce driving time to 15 minutes. Heavy cuts and fills feature construction of project, which includes two mechanically ventilated twin tunnels, one a mile long, designed by New York consulting firm of Smillie & Griffin and being built by Morrison-Knudsen Co., of Boise, Idaho. Photo was taken on March 21, 1952, during hoisting of 280-ft center section of forms for first bridges into position. One arch abutment and continuous deck for this now completed structure feature prestressed concrete construction. Bridges were designed by Jean Muller, chief engineer of E. Freyssinet's Paris organization, Société Technique pour l'Utilisation de la Precontrainte. Construction is being carried out by Empresas Campenon Bernard, Venezuela, under supervision of Robert Shama. Mr. Shama has prepared a paper on these bridges for presentation September 11 before joint session of ACI and Society's Structural Division during Centennial Convocation in Chicago. Superhighway project is being built by Venezuela Ministry of Public Works under engineering direction of Henrique Siblesz. Photo from Hamilton Wright, New York

Interpretation Defines "Professional Engineer"

For the benefit of employers of professional engineers, the Office of Salary Stabilization has released Interpretation No. 12, defining the scope of the amendment to the Defense Production Act that excludes from stabilization the salaries and other compensation of professional engineers. In Interpretation No. 12, the term "professional engineer" is defined "not only to assist employers in determining the personnel who are exempt but also to guard them against taking actions that might be in contravention of the Act and regulations." The definition follows:

"1. A professional engineer is a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to apply such special knowledge for the purpose of rendering professional services or accomplishing creative work, such as consultation, investigation, evaluation, planning, design, or supervision of construction for the purpose of assuring compliance with specifications and design in connection with structures, machines, processes, works or projects.

"2. A person is qualified as a professional engineer by reason of his professional education, if he holds a professional engineering degree from a college, university or institute of technology, authorized under the laws of the jurisdiction in which it is located to grant academic degrees in professional engineering.

"3. A person licensed or registered to practice as a professional engineer in any state, territory, or possession of the United States or in the District of Columbia is qualified as a professional engineer."

Persons who are not "professional engineers" are defined as follows:

"1. Persons engaged in carrying on routine mechanical activities, or persons employed as technicians or artisans (no matter how highly skilled), advisers on sales promotion, business methods and operations or in similar capacities, are not considered professional engineers. Consequently, persons whose occupations are designated as that of 'engineer,' such as stationary engineers, maintenance engineers, sales engineers or management or administrative engineers, are not professional engineers.

"2. Physicists, chemists, mathematicians, and other persons professionally employed in scientific fields, even though their scientific field or particular work activity may be related closely to professional engineering, are not professional engineers.

"3. Persons employed as engineering assistants, engineering aides, junior engineers or other 'engineering' personnel who may work in more or less close association with professional engineers, but who are not qualified to do the work of professional engineers, are not professional engineers."

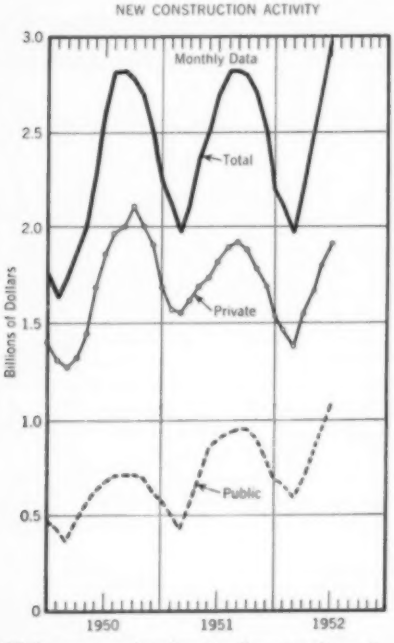
Geological Survey Reopens Uranium Testing Laboratory

The U.S. Geological Survey has reopened its uranium-testing laboratory at the University of Alaska in the Fairbanks area in an effort to aid uranium prospectors in their search for the critical mineral, according to Secretary of the Interior Oscar L. Chapman. Several field parties of the Survey will also be in Alaska this summer, he said, making reconnaissance studies in a joint program of the Survey and the Atomic Energy Commission to determine possibilities of the occurrence of high-grade uranium ores in the Territory. The work this season continues a program begun during World War II.

Record Construction Outlays in First Half of 1952 Reported

New construction expenditures during the first half of 1952 reached a record total of nearly $15 billion, according to a joint release of the Building Materials Division of the U.S. Department of Commerce and the U.S. Labor Department's Bureau of Labor Statistics.

The record outlay for the first six months of the year, representing a 4 percent rise over the 1951 total for the same period, is attributed to substantially increased expenditures for military facilities, industrial expansion, and public utility construction. Although military and defense plant construction was continuing to expand in June, a declining trend in private outlays for factories marked the completion of some important phases of the current industrial expansion program. Highway expenditures for the first half of the year were 14 percent above the total for the same period last year, and outlays for school building and public power facilities were moderately ahead of 1951.



With new construction for June totaling almost $3 billion, construction outlays for first half of year reached record total of almost $15 billion, Department of Commerce curves show.

Private spending for residential building during the first half of 1952 was 8 percent less than a year ago, with most of the reduction in volume in the first quarter of the year. In the early months of 1952, the level of work on new housing under construction was considerably lower than in the comparable period of 1951, when there was an exceptionally high rate of house and apartment construction. Second-quarter expenditures for new housing were almost as high this year as last, and dollar outlays for home improvements, in the form of additions and alterations, were greater.

Moderate expansion of most types of construction activity took place during June, with new construction totaling almost $3 billion—an increase of 7 percent over May and of 6 percent above June 1951. Private construction outlays of $1.9 billion for the month were about the same as a year ago, while public construction expenditures of almost $1.1 billion were 23 percent greater than in June 1951. The joint agencies note that commercial and recreational building picked up in June, partly as a result of approval by the National Production Authority of several hundred additional projects. Compared with 1951, however, these types of building activity were still at relatively low levels. Highway construction showed a substantial increase in June.

By the end of June about 10,933,000 tons of steel had been lost in the steel strike in late April, early May, and June, according to the American Iron and Steel Institute. The estimated loss is based on the assumption that if there had been no strike, steel output would have been at about the same rate as before the strike—about 2,091,000 tons a week.

Need for More Engineers Stressed at ASEE Meeting

The demand for engineering graduates still continues to outstrip the supply, according to figures released at the 60th annual meeting of the American Society for Engineering Education, held at Dartmouth College, Hanover, N. H., June 23–27. Maynard M. Boring, vice-president of the ASEE and chairman of a special survey committee of Engineers Joint Council, reported that less than 25,000 of this year's 30,000 engineering graduates will be available to industry and civilian government agencies because the ROTC alone will call over 4,500 to the armed services. There is an indicated demand for more than 50,000 new engineers, he said. This estimate of demand is based upon reports from 352 companies and government agencies representing nearly one-quarter of the engineering employment of the country.

In his presidential address, S. C. Hollister, M. ASCE, dean of the College of Engineering at Cornell University, pointed out that at the turn of the century there was one engineer for about 250 workmen, while today there is one engineer for about 50 workmen. However, the number of freshmen entering engineering is a fixed percentage of the population and has reached a stopping point.

Dean Hollister urged a complete reorganization of the profession in the next few years, "if engineering of the future is to be achieved at a level demanded by our economic system. In the gradual readjustment three major factors must be given special attention: (1) the training of more engineering aides, (2) a change in the practice of utilization of engineers; and (3) education of engineers themselves." Dean Hollister noted that during his term as president of ASEE, he had appointed a committee, headed by L. E. Grinter, M. ASCE, professor of civil engineering at Illinois Institute of Technology, "to stimulate a thorough review of engineering educational procedures in all parts of the country."

Other phases of engineering education

Willis R. Woolrich (left) dean of University of Texas and newly elected president of the American Society for Engineering Education, is congratulated by retiring president, S. C. Hollister, M. ASCE, dean of engineering at Cornell.

Directory of Modular Coordination Planned

As part of its modular coordination program for lower buildings costs, the Modular Coordination Office in Washington, D. C., is preparing a directory of modular-size building products.

In announcing the directory, William Demarest, Jr., secretary of the modular coordination program, said that, "In the initial two years just completed, impressive progress has been made in acquainting architects with the benefits to be gained through dimensioning by the modular method. The primary emphasis of our activities can now be placed upon serving architects, draftsmen, and builders who are changing from the old, traditional dimensioning habits and taking up the use of the modular system, which coordinates building dimensions with stock material sizes on the basis of the 4-in. module.

Other activities of the Modular Coordination Office, which was established in 1950 as a cooperative project of the American Institute of Architects and the Producers' Council, include publication of a bimonthly journal called *Modular Grid Lines*. As a supplemental cooperative activity, the Housing and Home Finance Agency is issuing a visual training aid for use this autumn in teaching the system in architectural and engineering colleges.

were discussed in papers by N. W. Dougherty, dean of engineering at the University of Tennessee; W. S. Evans, professor of civil engineering at the University of Maine; and D. F. Peterson, Jr., professor and head of civil engineering at Colorado Agricultural and Mechanical College. All are members of ASCE.

ASME Nominates New Officers for 1953

Nomination of Frederick S. Blackall, Jr., president and treasurer of the Taft-Peirce Manufacturing Co., of Woonsocket, R. I., as 1953 president of the American Society of Mechanical Engineers is announced. Four regional vice-presidents who will take office with him next December are: Henry R. Kessler, manager of the Republic Flow Meters Co., New York City; Paul R. Yopp, district sales manager of the Babcock & Wilcox Co., Atlanta, Ga.; Ben George Elliott, professor of mechanical engineering at the University of Wisconsin; and Harry R. Pearson, personnel director for the Dallas Power and Light Co., Dallas, Tex.

Government to Build Large Warehouses in New Jersey

Construction of four large government warehouses at Somerville, N.J., will get under way, following recent award of a $3,144,000 contract by the Public Buildings Service of the General Services Administration. The award was made to the Heckart Construction Co., Inc., of New York, N.Y., in a competitive bidding. Completion is expected in about seven months.

Contracts Awarded for Alaska Defense Projects

Announcement of two awards and three invitations to bid on Alaska defense projects is announced by the Corps of Engineers. The New York City firm of Grove, Shepherd, Wilson and Kruge has been awarded a contract for construction of airmen's dormitories at Elmendorf Air Force Base on its bid of $4,630,425. A contract for road and street paving at Fort Richardson has been given to Birch, Lytle and Green, of Seattle, on a bid of $1,097,314.

Invitations are being issued to bid on construction of a multi-million-dollar housing project for Elmendorf Air Force Base and two projects at Eielson Air Force Base—a 68,000-sq ft warehouse and four three-story airmen's dormitories and one mess and administration building.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"I was the guy, so I know," bragged Joe Kerr.

"What guy, and what?" twinquired Professor Neare.

"Otto Nobetta, and I know the answer."

"Which I'll explain," said Guest Professor Stoop Nagle. "Joe was the chap that interchanged the coordinates of one of the midpoints of the nonagonal tract so that the figure became an octagon of equal area. Not wanting to embarrass Joe, I referred him fictitiously as 'Otto Nobetta,' but now that he basks in his own notoriety, I'm going to ignore him and call on Cal Klater for the answer."

"Wait," complained Joe, "I'm always . . ."

"Hush, Junior," interrupted Cal. "If you do know the answer, you probably tried interchanging each of the nine sets of coordinates, which may be the quickest way, but it's very unprofessional. Using the conventional N for latitude and E for departure and the subscripts 1, 2, . . . 9 for the nine midpoints, I found the corner N_{91} between N_9 and N_1 was

$$N_{91} = N_1 + N_2 + N_5 + N_7 + N_9 - N_2 - N_4 - N_6 - N_8$$
$$= -\sum (-1)^r N_r \quad \ldots\ldots\ldots (1)$$

and similarly for E_{91} and analogously for all corners. Then, by the DMD method, the area of the nonagon is

$$A = 2\sum_{r=1}^{9} E_r \sum_{n=1}^{8} (-1)^{n+1} N_{r+n} \quad \ldots\ldots (2)$$

Now if we interchange coordinates E_1 and N_1, the change in the area is:

$$\Delta A = 2(E_1 - N_1)\sum_{r=2}^{9} (-1)^r (E_r + N_r) \quad \ldots (3)$$

which has to be zero. The solution $E_1 = N_1$, represented by the eighth point, is trivial, not changing the figure at all. So I computed the value of the summation, taking each point in turn as the starter, as follows:

N	E	N + E	$\sum$
50	74	124	318–330
31	68	99	330–343
12	62	74	343–355
6	40	46	355–371
12	18	30	371–371 = 0
37	12	49	371–352
56	34	90	352–330
62	62	124	330–318
62	74	136	318–318 = 0

Hence two different interchanges will give new figures with the same area. Making the ninth midpoint (74, 62), we get a nonagon which reverses the side thru the fifth point. Making the fifth point (18, 12), we get the required octagon, there being a zero side at the ninth point."

"Did you hear that, Joe? Now you not only know, but you know why. And let me add," concluded Professor Nagle, "that for a random set of midpoints, an oddagon is uniquely determined but an evenagon is generally non-existent."

"Thanks, Stoop, for the paragon of the non-octagon," said Professor Neare. "To cheer up Joe, the next problem is about three brash young ladies and two bashful boys at a leap-year party, playing the game called 'get your man.' Stretching out their daisy chain in a triangle with a girl at each vertex, they surrounded the boys. Art, shying from the girls, was 53.3 ft from each; Ben, shying from the chain, was 16.8 ft from each segment. How far was Cora from Dora if the chain between them was 40 ft from Elnora?"

[Cal Klaters were A. Nuther Nutt, Richard Jenney, Flo Ridan (Charles G. Edson), S. K. Rueball (Keith Jones), Sauer Doe (Marvin Larson) Julian Hinds and Thatchrite (Guy C. Thatcher). John L. (Stoop) Nagle was Guest Professor. Joseph M. Brandstetter suggested the pattern of the new problem.]

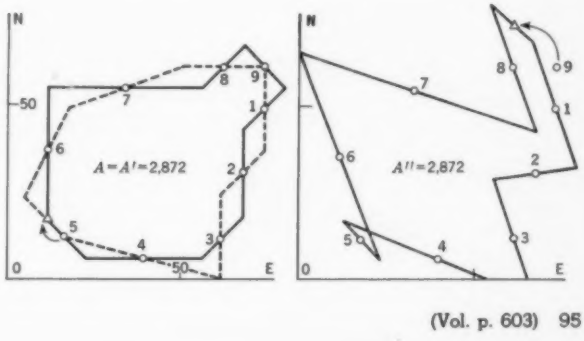


Fig. 1. Transposing coordinates of Point 5 degraded the nonagon to an equal octagon; transposing Point 9 held the area but inebriated the nonagon.

DECEASED

Frank Oliver Dufour, Former Director, Dies

Frank Oliver Dufour (M. '22) retired engineer and Director of the Society from 1927–1930, died at his home in Bethlehem, Pa., on April 9. He was 79. For several years Mr. Dufour taught at Lehigh University, the University of Wisconsin and the University of Illinois. He then engaged in private practice with David A. Keefe, consulting engineer of Athens, Pa., and later was with the Interstate Commerce Commission. Mr. Dufour became associated with Stone and Webster in 1916, as principal assistant to the structural engineer, resigning in 1922 to become head of the department of civil engineering and director of the Engineering Testing Laboratories at Lafayette College. He became connected with the Public Works Administration in 1933, and later was head of the Quartermaster General's office in Wilmington, Del. Mr. Dufour was an alumnus of Lehigh University.

Frank O. Dufour

Mastin Allen Acree (A.M. '44) senior engineer in the Washington, D.C., office of the Chief of Engineers, died at Arlington, Va., on April 22. He was 55 years old. After graduating from Virginia Polytechnic Institute, Mr. Acree was employed for several years as a transitman and draftsman-designer before entering government service in 1935. He rose from equipment engineer to engineer in charge of the labor relations program of the Corps of Engineers, at the district office in Charleston, S.C. During the second world war, Mr. Acree served as head of the expediting and inspection section in the Miami, Fla., district office.

George Neville Wheat (M. '21) retired engineer of San Antonio, Tex., died in that city, on June 22. He was 74. After graduating from the Agricultural and Mechanical College of Texas, and studying architectural engineering at the Massachusetts Institute of Technology, Mr. Wheat worked for several railroads, bridge companies and architects. He also held the positions of structural engineer in the office of the city engineer of Houston, Tex., and structural designer for Burnham Bros., and V. D. Simons, Inc., both of Chicago. From 1935 until his retirement in 1948, he was an associate structural engineer in the Construction Division of the Veterans Administration, Washington, D.C. Mr. Wheat was a captain in the U.S. Army during World War I.

James Murray Boyle (M. '16) retired engineer of New York and Connecticut died in New York City on June 18, at the age of 75. A veteran of World War I, Mr. Boyle served as a major in the Ordnance Department. Earlier he had been associated with Sanderson & Porter of New York City, for more than ten years. He was vice-president of the Underpinning & Foundation Co., New York, N.Y.; engineer and chemist for Boyle, Tolman & Travis, also of New York; and was connected with the Rural Electrification Administration in Washington, D.C., from 1936 until his retirement in 1941. He was a graduate of the University of Wisconsin.

Arthur Vincent Sheridan (M. '41) retiring Commissioner of Borough Works, in the Bronx, New York, N.Y., was killed in an automobile accident there on June 19. He was 64. Associated with municipal engineering and planning in the Bronx since 1920, Mr. Sheridan began his career as assistant engineer in the Public Works Department. Prior to his appointment as Commissioner of Borough Works in 1942, he served as engineer of design, chief engineer and commissioner of city planning. He had attended the City College of New York and the Sorbonne in Paris. Editor of the *American Engineer* for 12 years, Mr. Sheridan was the author of several books, had lectured on engineering history and philosophy, was active in professional affairs, and had taught at New York University. Twice he received Presidential commendations for engineering performed for the government.

Ambrose Beauchamp Brown (A.M. '20) commander, U.S.N. (retired), residing at Vacaville, Calif., died on May 24, at the age of 67. After studying at the New Mexico School of Mines, Mr. Brown was employed by the Hermosa Copper Co., in New Mexico, the Sunset Road Oil Co., and the city engineer's office in San Francisco, Calif. In 1919 he joined the U.S. Bureau of Public Roads as a highway engineer, and from 1926 until his retirement 21 years later he was in charge of the Bureau's office at Government Island, near Alameda, Calif.

Francis Fair Gillen (M. '16) retired engineer of McLean, Va., died on March 17, 1951, according to information received at Society headquarters. He was 76 years old. From 1899 to 1935 Mr. Gillen was connected in various capacities with the Office of Public Buildings and Grounds in Washington, D.C. Later he was an engineer with the National Park Service, advancing to the position of senior assistant superintendent of the National Capital Parks, which he held at the time of his retirement in 1950. Mr. Gillen was an alumnus of the University of Michigan.

Charles Winslow Riva (M. '42) president of the C. W. Riva Co. of Providence, R.I., died on June 26, at the age of 51. From 1927 to 1930, Mr. Riva was a designer for the Western Precipitation Co., Los Angeles, Calif., and from 1930 to 1936 he was associated with the firm of J. J. Coughlan & Sons, Inc., of Boston, Mass., as general superintendent and chief engineer. He served as chief engineer of the Board of Sewer Commissioners at Saugus, Mass., and was resident engineer for Fay, Spofford & Thorndike, a Boston firm, for several years before entering private practice. Mr. Riva is an alumnus of the Massachusetts Institute of Technology.

Virginius Leslie Taylor (M. '51) chief project engineer for the Ewin Engineering Corp., at Mobile, Ala., died there suddenly on June 19, at the age of 44. Upon graduation from the Alabama Polytechnic Institute, he was engaged as a resident engineer for the North Dakota Highway Department at Bismarck, N.D., for three years. Following that, Mr. Taylor was connected with the Alabama Highway Department at Montgomery, Ala., advancing from resident engineer to division construction engineer. He remained there from 1933 to 1942, except for two brief interludes—in 1928 when he worked for the S. R. Batson Construction Co., of Birmingham, Ala., and in 1940 when he served as first lieutenant in the construction division of the Quartermaster Corps, U.S. Army. Before joining the Ewin Engineering Co., Mr. Taylor held the rank of major in the Corps of Engineers at the Mobile Engineer District.

Augustus Clementine Spiker (M. '21) civil engineer of Bloomfield, Mo., died in Poplar Bluff, Mo., on June 14. He was 80 years old. Chief drainage engineer for Stoddard County, Missouri, and for the St. Francis River Levee, District 7, and Drainage District 41, Dunklin County, with headquarters at Bloomfield, Mr. Spiker had been serving the two counties continuously since 1900. Mr. Spiker had received degrees from Vincennes University and Purdue University, and taught at Purdue from 1896 to 1899.

T. Kennard Thomson, Former Director, Dies

T. Kennard Thomson, consulting engineer of New York City died at his home in Yonkers, N.Y., on July 1, at the age of 88. He was graduated from the University of Toronto in 1886 at the head of his class and later received the first degree of Doctor of Science awarded by his alma mater. During his early career he was associated with the Arthur McMullen Co., for nine years. In private practice since 1893, Dr. Thomson had participated in the construction of 50 major buildings and 200 bridges. He presented early plans for a belt line railroad and elevated highways to the Board of Estimate and Apportionment of New York City, and was noted for a plan to increase the Manhattan area by the fill method. Dr. Thomson was sixth on the list of veteran ASCE members, having joined as a Junior in 1888. He served the Society as Director from 1912 to 1914.

T. K. Thomson

In all the engineered construction markets, the CIVIL ENGINEER is the mainspring and the final authority.

As owner or top executive of contractor organizations, the Civil Engineer exercises key purchasing authority.

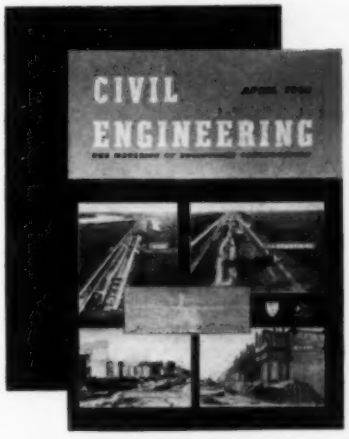
In his planning capacity, the Civil Engineer specifies the materials and equipment to be used on the project.

Then, in his supervisory capacity, the Civil Engineer directs the selection of, and approves the purchase orders for, equipment, materials and services.

Whatever the CIVIL ENGINEER'S title or function, he lives on product facts.

Today's record level of new engineered construction is keeping the Civil Engineer on the lookout more than ever . . . for improved equipment, materials and methods. He is vitally concerned with everything needed to complete his project speedily, efficiently, economically.

To keep up to date on all that's new, CIVIL ENGINEERS look to



Your fellow Civil Engineers can be told most effectively about your product or service in CIVIL ENGINEERING... the magazine of action in the engineered construction markets.

ABP ABC

...published by the American Society of Civil Engineers—first and oldest national engineering society in the United States.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

There IS a Difference in VIBRATORS

CONTRACTOR'S SELECTION OF VIBER VIBRATORS *EXCLUSIVELY* ON SOME OF THE LARGEST JOBS IN THE COUNTRY PROVE THIS STATEMENT

We have found over the past thirty years that cost conscious contractors are switching exclusively to Viber Vibrators on every type of concrete construction.

Knowing why may save your construction time and expense

MAINTENANCE AND DOWN TIME AMAZINGLY LOW WITH VIBER VIBRATOR

Viber Vibrators offer top performance day after day on the toughest jobs. Ability to absorb punishment comes from the built-in quality that comes only with research, experience, and manufacturing ability.

COMPLETE VIBER "PACKAGE" MEANS YOU CAN HANDLE ANY CONCRETE PLACEMENT JOB

Viber Company has progressively increased their line to provide all the equipment you need for smooth, low-cost operation. Interchangeability is an important feature of the Viber line.

REPEAT CUSTOMERS

In checking over our ever increasing customer list, we find that these contractors buy Viber Vibrators steadily year after year. This repeat business is indicative of the high regard contractors hold for the Viber line.

For details, see your Viber distributor or send for illustrated catalog.

VIBER COMPANY

Concrete Vibrators Since 1931

726 SOUTH FLOWER STREET

BURBANK, CALIFORNIA

Dept. 56

Fred Charles Augustus Claus (M. '41) district engineer for the New Jersey State Highway Department died on March 1. He was 62 years old. In 1907, at the outset of his career, Mr. Claus joined Franklin & Co., civil and consulting engineers of Philadelphia, Pa., advancing to principal assistant engineer by 1920, when he left to work for Gillespie & Franklin, also of Philadelphia, as superintendent of construction. Connected with the New Jersey Highway Department since 1923, Mr. Claus played a part in the design of the New Jersey approaches for the Philadelphia and Camden Bridge, and the George Washington Bridge.

George Francis Cant, Jr. (A.M. '33) park engineer, Palisades Interstate Park Commission, at Bear Mountain, N.Y., died November 19, 1951, at the age of 48. From 1930 until 1935 Mr. Cant was connected with the Long Island State Park Commission and Jones Beach State Parkway Authority at Babylon, N.Y. Following that, he was associated briefly with Madigan-Hyland, and the Board of Design of the Metropolitan Life Insurance Co., both in New York City. Mr. Cant was in private practice in New York before accepting the post of park engineer, which he had held for more than six years. He was an alumnus of Rensselaer Polytechnic Institute.

Richard Charles Sanchez Watson (A.M. '27) consulting engineer of Texcoco, Mexico, died in Monterrey, on May 22. He was 76. Mr. Watson had been employed in many capacities in South Africa, South America, the United States, and Mexico during his career. While in this country he worked for the Missouri Pacific Railroad, the St. Louis & San Francisco Railway, the United Line Corp. of Houston, Tex., and was a member of the firm of Howorth and Watson. In Mexico, Mr. Watson was connected with several firms including the Mexican Zinc Co., and Cementos Aloyac, S.A. He had studied at St. Pauls School and the Royal School of Mines in London, England.

Carlos Quirino Simoes (M. '31) administrative director, State Highway Department, São Paulo, Brazil, died on April 19 at the age of 69. Mr. Simoes was engaged in railroad engineering for several years before becoming assistant state district engineer and then district engineer. His next position was as designing engineer of the Viaducto Boa Vista in São Paulo and then assistant director of the State Highway Department from 1927 to 1931. Mr. Simoes practiced privately for several years before he was designated head of the State Highway Department, a position he held from 1939 until his death. He had graduated with the degree of architect engineer from the Escola Polytechnica de São Paulo.

Frank Colburn Bowler (M. '13) consulting engineer for the Great Northern Paper Company, of Millinsocket, Me., died there recently, at the age of 78. Since 1911, Mr. Bowler has been associated with the paper company as head of the engineering department and chief engineer. Prior to that, he worked briefly for the New England Sulphite Digester Co., the Washington County

Railroad, and the city engineer of Bangor, Me. He was also associated with H. S. Ferguson as an assistant engineer for 14 years. Mr. Bowler was an alumnus of Maine State College.

George Gerald FitzGerald (A.M. '20) consulting engineer of Camarillo, Calif., died on April 10, at the age of 65. Engaged in private practice since 1920, Mr. FitzGerald had served as consultant to such groups as the Santa Rosa Valley Protective Association, the Newhall Land & Farming Co., the Oxnard Drainage District, and the Santa Clara River Protective Association at Oxnard, Calif. He was a specialist in land development and irrigation and drainage problems. During the first World War, Mr. FitzGerald served as a lieutenant in the Corps of Engineers.

John Wellington Stewart (A.M. '07) retired engineer of Hugoton, Kans., died recently at the age of 83. Engaged in railway work during his entire career, Mr. Stewart was a location and construction engineer for the Atchison, Topeka & Santa Fe Railway from 1902 until 1937, when he retired. He also worked in the railroad's valuation department for two years, and as a draftsman for five years.

Byrle Burton Womble (A.M. '49) civil engineer with J. W. Shikles & Co., of Kansas City, Mo., died on May 24 at the age of 39. Before obtaining a degree in civil engineering from Kansas State College in 1944 he worked as a draftsman and resident engineer for Sedgwick County, Kansas, and senior engineering aide in the U.S. Engineer Office at Little Rock, Ark. Following his graduation, he worked for two years with Howard, Needles, Tammen & Bergendoff in Kansas City, Mo. Mr. Womble joined the firm of J. W. Shikles & Co., as design engineer in 1946.

Solution to problem on page 41

In any interchange of bearing, the new or substitute foundation needs to be brought to a forced fit, by jacks or other means, until the load is actually lifted from the old foundation. Otherwise the new foundation will undergo its initial settlement and deformation as the load descends on it, and this settlement and deformation will represent movement which the wall will undergo along with the foundation. A somewhat analogous situation is encountered when an arch is bricked in with a view to relieving it of its load. If the arch is not actually broken down, it will continue to function as an arch until it fails, permitting its load to settle onto the plug with more movement than may be desirable.

Familiar Scenes
ON CONSTRUCTION JOBS

Water Lines by NAYLOR

When construction jobs call for water lines, there's good reason why contractors specify Naylor pipe. Its light-weight makes for easier handling and installation. Its distinctive lock-seamed and spiral-welded structure assures extra strength and safety. When connected with the time-saving Naylor Wedge-Lock coupling, it gives you the most practical combination for the heavy-duty service you require.

Write for Bulletins No. 507 and No. 513.

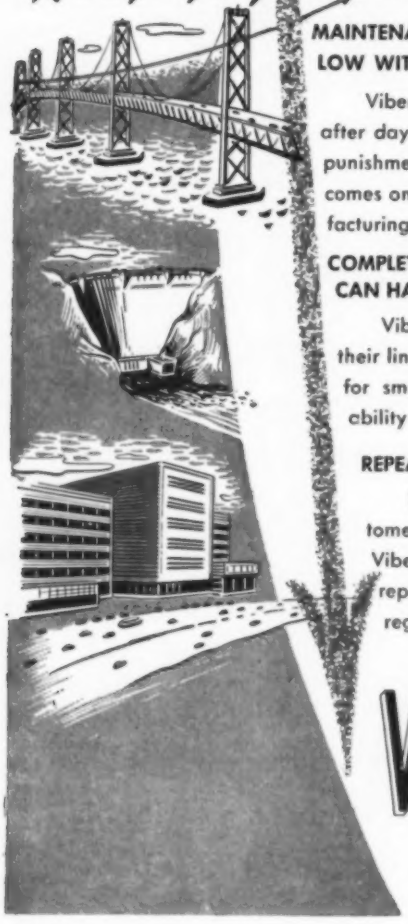
Naylor Pipe Company
1281 E. 92nd St., Chicago 19, Ill.
New York Office:
350 Madison Ave., New York 17, N.Y.

There IS a Difference in VIBRATORS

CONTRACTOR'S SELECTION OF VIBER VIBRATORS *EXCLUSIVELY* ON SOME OF THE LARGEST JOBS IN THE COUNTRY PROVE THIS STATEMENT

We have found over the past thirty years that cost conscious contractors are switching exclusively to Viber Vibrators on every type of concrete construction.

Knowing why may save you construction time and expense



MAINTENANCE AND DOWN TIME AMAZINGLY LOW WITH VIBER VIBRATOR

Viber Vibrators offer top performance day after day on the toughest jobs. Ability to absorb punishment comes from the built-in quality that comes only with research, experience, and manufacturing ability.

COMPLETE VIBER "PACKAGE" MEANS YOU CAN HANDLE ANY CONCRETE PLACEMENT JOB

Viber Company has progressively increased their line to provide all the equipment you need for smooth, low-cost operation. Interchangeability is an important feature of the Viber line.

REPEAT CUSTOMERS

In checking over our ever increasing customer list, we find that these contractors buy Viber Vibrators steadily year after year. This repeat business is indicative of the high regard contractors hold for the Viber line.

For details, see your Viber distributor or send for illustrated catalog.

VIBER COMPANY
Concrete Vibrators Since 1931
726 SOUTH FLOWER STREET
BURBANK, CALIFORNIA
Dept. 56

Fred Charles Augustus Claus (M. '41) district engineer for the New Jersey State Highway Department died on March 1. He was 62 years old. In 1907, at the outset of his career, Mr. Claus joined Franklin & Co., civil and consulting engineers of Philadelphia, Pa., advancing to principal assistant engineer by 1920, when he left to work for Gillespie & Franklin, also of Philadelphia, as superintendent of construction. Connected with the New Jersey Highway Department since 1923, Mr. Claus played a part in the design of the New Jersey approaches for the Philadelphia and Camden Bridge, and the George Washington Bridge.

George Francis Cant, Jr. (A.M. '35) park engineer, Palisades Interstate Park Commission, at Bear Mountain, N.Y., died November 19, 1951, at the age of 48. From 1930 until 1935 Mr. Cant was connected with the Long Island State Park Commission and Jones Beach State Parkway Authority at Babylon, N.Y. Following that, he was associated briefly with Madigan-Hyland, and the Board of Design of the Metropolitan Life Insurance Co., both in New York City. Mr. Cant was in private practice in New York before accepting the post of park engineer, which he had held for more than six years. He was an alumnus of Rensselaer Polytechnic Institute.

Richard Charles Sanchez Watson (A.M. '27) consulting engineer of Texcoco, Mexico, died in Monterrey, on May 22. He was 76. Mr. Watson had been employed in many capacities in South Africa, South America, the United States, and Mexico, during his career. While in this country he worked for the Missouri Pacific Railroad, the St. Louis & San Francisco Railway, the United Line Corp. of Houston, Tex., and was a member of the firm of Howorth and Watson. In Mexico, Mr. Watson was connected with several firms including the Mexican Zinc Co., and Cementos Aloyac, S.A. He had studied at St. Paul's School and the Royal School of Mines in London, England.

Carlos Quirino Simoes (M. '31) administrative director, State Highway Department, São Paulo, Brazil, died on April 19 at the age of 69. Mr. Simoes was engaged in railroad engineering for several years before becoming assistant state district engineer and then district engineer. His next position was as designing engineer of the Viaducto Boa Vista in São Paulo and then assistant director of the State Highway Department from 1927 to 1931. Mr. Simoes practiced privately for several years before he was designated head of the State Highway Department, a position he held from 1939 until his death. He had graduated with the degree of architect engineer from the Escola Polytechnica de São Paulo.

Frank Colburn Bowler (M. '13) consulting engineer for the Great Northern Paper Company, of Millinsocket, Me., died there recently, at the age of 78. Since 1911, Mr. Bowler has been associated with the paper company as head of the engineering department and chief engineer. Prior to that, he worked briefly for the New England Sulphite Digester Co., the Washington County

Railroad, and the city engineer of Bangor, Me. He was also associated with H. S. Ferguson as an assistant engineer for 14 years. Mr. Bowler was an alumnus of Maine State College.

George Gerald FitzGerald (A.M. '20) consulting engineer of Camarillo, Calif., died on April 10, at the age of 65. Engaged in private practice since 1920, Mr. FitzGerald had served as consultant to such groups as the Santa Rosa Valley Protective Association, the Newhall Land & Farming Co., the Oxnard Drainage District, and the Santa Clara River Protective Association at Oxnard, Calif. He was a specialist in land development and irrigation and drainage problems. During the first World War, Mr. FitzGerald served as a lieutenant in the Corps of Engineers.

John Wellington Stewart (A.M. '07) retired engineer of Hugoton, Kans., died recently at the age of 83. Engaged in railway work during his entire career, Mr. Stewart was a location and construction engineer for the Atchison, Topeka & Santa Fe Railway from 1902 until 1937, when he retired. He also worked in the railroad's valuation department for two years, and as a draftsman for five years.

Byrle Burton Womble (A.M. '49) civil engineer with J. W. Shikles & Co., of Kansas City, Mo., died on May 24 at the age of 39. Before obtaining a degree in civil engineering from Kansas State College in 1944 he worked as a draftsman and resident engineer for Sedgwick County, Kansas, and senior engineering aide in the U.S. Engineer Office at Little Rock, Ark. Following his graduation, he worked for two years with Howard, Needles, Tammen & Bergendoff in Kansas City, Mo. Mr. Womble joined the firm of J. W. Shikles & Co., as design engineer in 1946.

Solution to problem on page 41

In any interchange of bearing, the new or substitute foundation needs to be brought to a forced fit, by jacks or other means, until the load is actually lifted from the old foundation. Otherwise the new foundation will undergo its initial settlement and deformation as the load descends on it, and this settlement and deformation will represent movement which the wall will undergo along with the foundation. A somewhat analogous situation is encountered when an arch is bricked in with a view to relieving it of its load. If the arch is not actually broken down, it will continue to function as an arch until it fails, permitting its load to settle onto the plug with more movement than may be desirable.

Familiar Scenes
ON CONSTRUCTION JOBS

Water Lines by NAYLOR

When construction jobs call for water lines, there's good reason why contractors specify Naylor pipe. Its light-weight makes for easier handling and installation. Its distinctive lock-seamed and spiral-welded structure assures extra strength and safety. When connected with the time-saving Naylor Wedge-Lock coupling, it gives you the most practical combination for the heavy-duty service you require.

Write for Bulletins No. 507 and No. 513.

Naylor Pipe Company
1281 E. 92nd St., Chicago 19, Ill.
New York Office:
350 Madison Ave., New York 17, N.Y.

NEWS OF ENGINEERS

Wendell D. Anderson, who has traveled in the Southeast for many years in the interests of clay pipe sanitary engineering and consulting services, has recently organized the Sanitary Engineering Service, Inc., in Atlanta, Ga.

Ford Bartlett, president of Lockwood, Kessler & Bartlett, Inc., Great Neck, N.Y., has been elected chairman of the Association of Professional Photogrammetrists, succeeding **Virgil Kauffman,** president of the Aero Service Corp., Philadelphia, Pa.

Charles C. Cassel, assistant district engineer, New York State Department of Public Works, has been given a provisional appointment as district engineer in the Watertown District, following the retirement of **Roy Hall.**

Paul J. Prout, consulting engineer of Long Beach, Calif., has assumed duties with the Federal Civil Defense Administration as regional coordinator for California, Utah, Arizona and Nevada, at Berkeley, Calif.

Homer M. Hadley, Seattle consulting engineer, has formed a partnership with his son, **Richard H. Hadley,** known as Hadley and Hadley, with offices in Seattle, Wash.

Frederick W. Clayton, consulting engineer of Reno, Nev., and Berkeley, Calif., returned recently from Rangoon, Burma, after completing a job as supervising engineer for the construction of Mingaladon airdrome at the Burmese national airport.

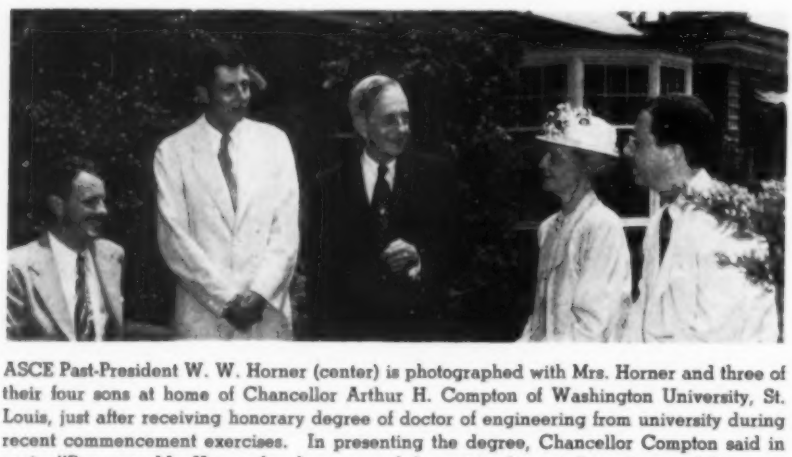
J. Bres Eustis and **Charles A. Bragg,** of the Eustis Engineering Company, which specializes in foundation engineering, have announced the opening of their new office building at 3635 Airline Highway, New Orleans, La.

Delbert B. Freeman, colonel, Corps of Engineers, and District Engineer of the Fort Worth District since its establishment two years ago, has been assigned as Division Engineer of the Upper Mississippi Valley Division with headquarters at St. Louis, Mo.

Daniel H. Harkness, secretary of W. & L. E. Gurley, Troy, N.Y., has been named sales manager of the firm. Mr. Harkness has been a member of the sales department since 1943.

James T. Holmes, president of Holmes & Narver, Inc., recently announced the opening of expanded engineering facilities and executive offices at 828 South Figueroa Street, Los Angeles, Calif.

W. F. Moehlman and **Ernest M. Barnes** are president and secretary-treasurer of a newly-formed corporation, the General Aggregate Corp., organized for the manufacture of red shale slag concrete aggregate. The headquarters of the new organization will be in Lake City, Fla.



ASCE Past-President W. W. Horner (center) is photographed with Mrs. Horner and three of their four sons at home of Chancellor Arthur H. Compton of Washington University, St. Louis, just after receiving honorary degree of doctor of engineering from university during recent commencement exercises. In presenting the degree, Chancellor Compton said in part: "For years Mr. Horner has been one of the outstanding civil engineers of this community. He has served the City of St. Louis in numerous engineering capacities and his counsel on matters pertaining to municipal and sanitary engineering has been sought by many state and national committees and boards. For several years he also served Washington University as Professor of Municipal and Sanitary Engineering. He pioneered in applying the science of hydrology to many complex problems within our highly developed urban communities; in this connection he has guided public opinion when conflicts developed between sound judgment and Federal long-range planning for the development and use of water." Mr. Horner received from Washington University the degree of Bachelor of Science in Civil Engineering in 1905 and the professional degree of Civil Engineer in 1909.

Edward S. Nuss, lieutenant, CEC, U.S. Navy, formerly stationed in Washington, D.C., has been transferred to the U.S. Naval Air Facility at Litchfield Park, Ariz.

Warren S. Mann has been promoted from sales manager to manager of the Dixie Division of Armco Drainage and Metal Products, Inc., with headquarters in Atlanta, Ga.

James P. Michalos has been promoted from associate professor to full professor in the department of civil engineering at Iowa State College.

Thomas C. Kavanagh, professor of civil engineering at Pennsylvania State College since 1948, has been appointed professor of structural engineering and chairman of the department of civil engineering at New York University. Dr. Kavanagh taught at New York University from 1946 to 1948, holding the title of assistant professor of civil engineering.

Lawrence H. Daniels, who was formerly employed by Clair A. Hill in Redding, Calif., has accepted a position as structural engineer with John Blume in San Francisco.

Curt A. Matyas, assistant highway engineer, California State Division of Highways, Sacramento, has been recalled to active duty in the Navy and is now stationed at the Marine Corps Air Station, Miami, Fla.

Nomer Gray and **Leopold H. Just** have been appointed associates in the consulting engineering firm of Ammann & Whitney, of New York City and Milwaukee, Wis. Until recently Mr. Gray was resident engineer in the firm's New York office.

Carl A. Arenander, Robert D. Mitchell, and **Malcolm Pirnie, Jr.,** associate engineers with Malcolm Pirnie Engineers, of New York City, have been admitted to partnership in the firm.

W. H. Wisely, executive secretary and editor for the Federation of Sewage and Industrial Works Associations, Champaign, Ill., has been appointed Illinois commissioner on the Ohio River Valley Sanitation Commission, to fill the unexpired term of the late **Jesse Woltmann.**

Three Society members—**Frank Melville Heroy, Jr.,** assistant traffic engineer, Division of Traffic Engineering, New Orleans, La.; **Richard Herman Kanak,** staff traffic engineer, Cook County Traffic Safety Foundation, Chicago, Ill.; and **Edward Albert Mueller,** of Ammann & Whitney, Milwaukee, Wis.—are among fourteen graduate engineers receiving fellowships and scholarships from the Yale University Bureau of Highway Traffic.

Dwight W. Winkelman, president of the D. W. Winkelman Co., Inc., of Syracuse, N.Y., and past-president of the AGC, has been awarded an honorary degree of doctor of science by Morningside College, Sioux City, Iowa.

William Roy Glidden, bridge engineer of the Virginia Department of Highways for the past 35 years and a Vice-President of ASCE, has been promoted to the post of assistant chief engineer succeeding the late **Lewis E. Akers. John Norwood Clary,** assistant bridge engineer, has been elevated to the post of bridge engineer. Other promotions made in the Bridge Engineer's Office include the naming of **Carol C. Battige** and **Thomas J. Ogburn III,** as assistant bridge engineers.

W. R. Glidden

Everett W. Fowler, engineer with the National Board of Fire Underwriters in New York City, was recently appointed director of its newly-created division of codes and standards.

Gen. Lucius D. Clay, chairman of the board of the Continental Can Co. and former commander of the American Occupation Forces in Germany, was the principal speaker at commencement exercises at Trinity College. The general was the recipient of an honorary degree of doctor of laws.

Harrison F. Gonnerman and **William Lerch** of the Portland Cement Association, received the Sanford E. Thompson Award at the 50th anniversary meeting of the American Society for Testing Materials, held June 25 in New York. Mr. Gonnerman is assistant to the vice-president for research and development and a veteran of 30 years' service with the Association, and Mr. Lerch is administrative assistant in the research and development division.

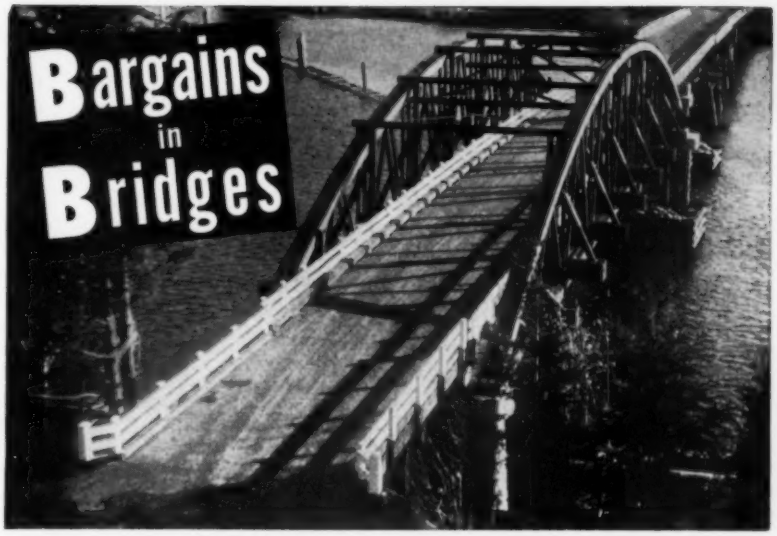
Carl B. Jansen, president of the Dravo Corp., Pittsburgh, Pa., has been elected a trustee of his alma mater, Union College, Schenectady, N.Y.

John Mason, Jr., has joined the staff of the Atlantic Research Corp., at Alexandria, Va., to work with the firm's electromechanical division. Previous to his appointment, Mr. Mason was with the Naval Research Laboratories in Washington, D.C.

Richard D. Matchette, corporal, U.S. Army, recently graduated second in his class from the XVI Corps' Leaders' School at Camp Matsushima, Japan. Before entering the Army, he was a civil engineer with the U.S. Bureau of Reclamation at Coulee Dam, Wash.

Raymond Martin, formerly chief engineer on the construction of the Mt. Morris Dam on the Genesee River in New York State, is now vice-president in charge of engineering with the George Vang Construction Co., of Pittsburgh, Pa.

(*Continued on page 110*)



566-foot bridge across Smith River in Douglas County, Oregon. Truss section fabricated by Timber Structures, Inc.

Permanent bridges needed to keep essential traffic moving are readily available in spite of certain material shortages. These are of engineered timber construction, fabricated by Timber Structures, Inc.

The bridge shown here is typical of this construction. It is an actual demonstration of how to build permanent, serviceable, trouble-free bridges on limited budgets. Here are the details of this job:

Bridge is 566 feet long overall, with truss section of 183 feet, and portal clearance of 15 feet. Clear width of roadway is 20 feet, with wearing surface of asphalt bituminous, supported by 2x10 laminations. H-20 loading. Truss chords are glued laminated Douglas fir members, preservative treated and joined to other bridge members with split ring connectors. Total cost of the bridge, including concrete piers, was approximately $150,000.

Five Basic Types of Engineered Timber Bridges

The bowstring truss bridge is only one of five basic types. Others are deck arch, girder, composite deck and parallel chord truss. All five types may be given any desired preservative treatment to protect them against attack by decay or termites.

These bridges are described and illustrated in a new brochure, "Permanent Timber Bridges". Your nearest Timber Structures representative has a copy for you; or you may obtain one by filling out and mailing the coupon below.

TIMBER STRUCTURES, INC.

P. O. BOX 3782-Y, PORTLAND 8, OREGON

Offices in New York; Chicago; Detroit; Kansas City; Dallas; Seattle; Spokane.

TIMBER STRUCTURES, INC. OF CALIFORNIA • Oakland, California

TIMBER STRUCTURES OF CANADA, LTD. • Peterborough, Ontario

Local Representatives throughout the United States and Canada

TIMBER STRUCTURES, INC.
P. O. Box 3782-Y, Portland 8, Oregon
Please send me your folder "Permanent Timber Bridges".

Name_____

Company_____ Position_____

Address_____ Zone_____

City_____ State_____

ENGINEERING SOCIETIES

PERSONNEL SERVICE, INC.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 W. 40th ST.	84 E. RANDOLPH ST.	100 FARNSWORTH AVE.	57 POST ST.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL ENGINEER; J. M. ASCE; 32; married; graduate civil engineer; with 2 years' experience in surveying and design and construction of irrigation and domestic water systems; 7 months' experience as manager; 5 years' responsible work with Air Force. Desires position with consulting engineer or contractor. C-765-487-A-1-San Francisco.

SANITARY ENGINEER; J. M. ASCE; M. S. in S. E.; registered professional engineer; 27; married; 1 year of experience with structural engineering firm; 4 years in water supply and sewerage field with state health agency. Desires responsible position in which sanitary public health engineering experience may be utilized. C-766.

CIVIL ENGINEER; M. ASCE; degree; 47; married; many years' experience in construction of concrete and earth dams, bridges, roads, pipelaying, water-works, dock/marine works, thermal stations, heavy public works, industrial plants, reinforced concrete and steel-framed buildings. Desires position India, Near or Far East. Has travelled extensively in Eastern countries. C-767.

BUILDING ENGINEER; M. ASCE; graduate civil engineer; registered in New York and New Jersey; 30 years' experience in all types of building construction, office or field work. Overall administrative officer. Willing to travel. C-768.

CONSTRUCTION EXECUTIVE; J. M. ASCE; 32; married; general management all phases of large-scale general contracting; multiple housing, hospitals, public works, industrial buildings. Full knowledge of estimating, purchasing, field work, subcontract negotiations, labor. Also experienced business management engineer; reorganization, financial planning, profit controls. Location, western United States only. C-769-524-A-4-San Francisco.

Positions Available

CONSTRUCTION FIELD SUPERINTENDENT, experienced in all phases of heavy industrial construction, to direct work on major construction projects. Will supervise division engineers. Location, Delaware. Y-6193.

SALES ENGINEER, preferably mechanical or civil graduate, under 40, for company selling pneumatic conveying equipment, automatic scales, storage silos and air compressors to industrial, chemical and cement-using industries. Salary, $4,000–$5,000 a year, depending on experience, plus share in profits on completion of about 1 year of training. Territories, western Pennsylvania, Ohio, and West Virginia. Y-6487.

FIELD INSTALLATION ENGINEER, civil or mechanical training with tunneling and heavy construction experience, for service and installation of tunnel-lining materials. Salary open. Location, Midwest. Y-6612.

CIVIL ENGINEER, graduate, with at least 8 years' design and field experience on waterfront construction, pumphouse, office building, tank foundations, to design bulk terminals with occasional field inspection work. Salary, $6,000–$8,000 a year. Location, New York, N. Y. Y-6647.

CONSTRUCTION SUPERINTENDENT, civil graduate, 35–45, with at least 5 years' field engineering and supervisory building construction experience, to take charge of housing projects, hospitals, etc., for general contractor. Salary, $6,000–$9,000 a year. Location, Panama and Caribbean area. Y-6655.

EXECUTIVE ARCHITECT, graduate, registered architect, with at least 10 years' industrial, institutional and commercial experience covering design, staff, public relations, contracts, field and sales, to take charge of department meeting prospects, handling clients, and managing architectural staff for consulting firm. Salary, $8,000–$10,000 a year, plus bonus. Location, Southeast. Y-6783.

ENGINEERS, (*a*) Structural Designer, with 7 to 10 years' experience, to supervise checking and shop drawings of concrete and steel on heavy construction. (*b*) Estimator with highway experience. Must have good solid background on heavy construction estimating. Building construction not satisfactory. (*c*) Highway Designer with 2 to 4 years' experience. Salaries open. Location, New York, N. Y. Y-6807.

CIVIL ENGINEERS, (*a*) Civil Engineer, graduate, who has had some municipal experience, particularly on streets and sewers. Salary, $4,740–$5,960 a year. (*b*) Junior Civil Engineer, graduate, with about a year's experience in general civil engineering and some knowledge of streets and sewers. Salary, $3,660–$4,560 a year. Must be residents of northern New Jersey. Y-6856.

PROJECT EVALUATOR, 26–35, with construction experience, interested in detail cost appraisal work. Good opportunity. Location, Delaware. Y-6886.

CIVIL ENGINEER, 40–45, with 10 to 15 years' experience in structural design and office engineering experience, to prepare plans, specifications, etc., on oil field construction projects. Salary, $11,640 a year base pay, plus $4,200 a year allowance. Location, South America. Y-7112.

CIVIL ENGINEER, young, graduate, preferably with some experience in the maintenance of track and track equipment, for work in railroad department. Summer experience acceptable. Location, Chile. Y-7154 (*a*).

GENERAL SUPERINTENDENT OF CONSTRUCTION to take charge of construction of a paper mill abroad. Must have paper mill construction experience. Salary open. Y-7170.

ENGINEER, B. S. in civil engineering or equivalent, to include most of the following courses: dynamics, aerodynamics, differential equations, statistics, stress analysis, structural design; to plan, conduct and evaluate field tests of operational engineering techniques. Will consider a recent graduate. Salary, $3,410–$5,940 a year. Location, Virginia. Y-7202.

MUNICIPAL ENGINEER, with degree in civil engineering. Minimum of 5 years' experience in the municipal public works field and related work. Thorough knowledge and ability to supervise the construction and maintenance of streets, sewers, surface drains, etc. Ability to administer and enforce the building, zoning and other codes and ordinances covering construction and alteration and related work essential. Must be able to develop new methods and procedures for the performance of various operations of a municipal public works department. Location, New York Metropolitan area. Y-7210.

CIVIL ENGINEER to take charge of a large cement plant. Salary, $25,000 a year. Location, New York, N. Y. Y-7253 (*b*).

RESIDENT ENGINEER, civil graduate, to take complete charge of the construction of a large paper mill in Georgia. Salary open. Y-7262.

INSTRUCTOR in civil engineering, to teach in the fields of fluid mechanics and soil mechanics. Should have at least an M. S. degree, preferably a doctor's degree. Salary open. Location, Connecticut. Y-7274.

CIVIL ENGINEER, graduate, with at least 3½ years' experience in civil engineering. Must have demonstrated a thorough knowledge of engineering principles and their application; show ability to direct and coordinate engineering activities and a high degree of technical competence in the solution of unusually complex and difficult engineering problems. Will be responsible for the technical continuity of long-range maintenance and development programs; represent Public Works Officer at conferences with private architects and engineers engaged in the preparation of plans and specifications for development and rehabilitation programs; supervise work of subordinate engineering personnel. Will be responsible for initiating and coordinating plans for the development and maintenance of naval base. Salary $7,040 a year. Location, East. Y-7279.

SOILS ENGINEER, at least a master's degree in soils, to conduct complete soil engineering studies including field-boring programs, in situ field testing, laboratory testing and office studies and design. Will supervise project through the field, laboratory and office stages to the writing of the final report or preparing of the final design. Salary open. Location, Canada. Y-7280.

ENGINEERS, (*a*) Planning Engineer, graduate civil, preferably with several years' experience in this field. Familiarity with methods of surface and subsurface exploration, preliminary studies and estimates for engineering projects including such items as dams, canals, spillways, power plants, roads, bridges, hydraulic and electric equipment. Facility with hydraulic problems and economic studies of steam and hydroelectric projects. Ability to write clear and accurate engineering reports. Salary open. (*b*) Office Engineer, graduate, preferably with experience in office practice and procedures in engineering and construction field. Aptitude for construction cost accounting, cost and budget estimates, payroll and personnel procedures, office management, etc.; and writing clear and accurate engineering reports and letters. Salary open. (*c*) Plant and Materials Engineer, graduate civil engineer, preferably with knowledge in related mechanical, electrical and structural fields and some familiarity with construction plant and equipment used in heavy engineering construction such as dams, spillways, canals, etc. Ability to make economic studies for plant layouts and construction methods and materials. Ability to write clear and accurate engineering reports. Salary open. (*d*) Specifications Engineer, graduate, with ability to write clear and accurate engineering specifications, reports and letters and ability to edit similar material; general knowledge of engineering materials, construction equipment and methods relating to the design and construction of dams, spillways, canals, gates, power houses, etc., particularly in the hydraulic and electric field. Salary open. Location, Puerto Rico. Y-7288.

ASSISTANT CHIEF ENGINEER, about 50, with at least 10 years' experience in structural design of materials-handling equipment. Knowledge of silo design and functions. Should have license. Will assist chief engineer in small engineering department handling design and installation of bulk materials handling equipment. Moving expenses paid. Salary, $10,000–$12,000 a year. Employer will pay fee. Location, New York, N. Y. Y-7290-T-9023.

CHIEF ENGINEER to take complete charge of the operation and engineering for water work operated from artesian wells. Salary open. Location, Persia. Y-7298.

ASSISTANT OR ASSOCIATE PROFESSOR in civil engineering, to handle instruction in fluid mechanics and hydraulic laboratory. Will consider young instructor interested in graduate work. Salary commensurate with qualifications. Location, South. Y-7306.

DESIGNERS, structural and hydraulic, with 3 to 5 years' experience preferably in water or sewerage treatment plants. Salary open. Location, New York, N. Y. Y-7314.

BRIDGE DESIGNER, civil engineer with 5 years' experience in steel and concrete design. Knowledge of bridge design, particularly steel, desirable. Will design and draw up own work for a consultant. Salary, $6,000–$6,300 a year. Employer will pay fee. Location, Chicago, Ill. R-8991.

ENGINEERS WANTED

STRUCTURAL ENGINEER

Graduate Engineer, 10 years experience, design of heavy structures with emphasis on long span bridges.

MACHINE DESIGNER

Graduate Engineer, 3 to 5 years experience, design of heavy machinery, as applied to movable bridges.

DESIGN DRAFTSMEN

3 to 5 years experience on heavy structures. Experience on long span bridges desirable.

SANITARY ENGINEER

Graduate Engineer, 3 to 5 years experience, design and layout of sewage collection and water distribution systems. Design of small to medium sized sewage treatment and water purification works.

TRAFFIC STUDY ENGINEER

Graduate Engineer, 5 to 10 years experience in traffic engineering, including origin and destination surveys and analyses.

SOIL MECHANICS ENGINEER

Graduate Engineer. 5 years experience in consolidation, triaxial shear, and other soils tests, settlement and slope stability analyses and supervision of soils laboratory.

SPECIFICATION WRITER

Graduate Engineer. Responsible experience in writing specifications for heavy civil engineering work. Must have ability to correlate specifications for incidental architectural, mechanical and electrical phases of work into completed specification.

PROJECT PLANNING ENGINEER

Graduate Civil Engineer. Broad, diversified experience in planning, design, construction, cost estimates, and comprehensive analyses of problems of construction to be used in connection with sales of engineering services.

CHIEF OF PARTY

Graduate Engineer. Responsible experience in supervision of First Order Geodetic Triangulation, Precise Levels and Lambert and Transverse Mercator coordinates.

OBSERVERS

Experienced in use of theodolite for geodetic surveying.

COMPUTERS

Experienced in computing First Order Triangulation and Lambert and Transverse Mercator coordinates.

LIBERAL SALARIES

commensurate with experience and ability. Vacations with pay and other benefits.

SUBMIT COMPLETE RÉSUMÉ

of education and experience, salary requirement, references, and availability date with first letter.

PALMER AND BAKER, INC.
CONSULTING ENGINEERS—ARCHITECTS
P. O. Box 346
Mobile, Alabama

Structural Engineer

Minimum four years' experience in steel or reinforced concrete problems.

WE OFFER:

- **Attractive salary with considerable premium overtime**
- **Excellent opportunity to assume additional responsibility**
- **Liberal Employee Benefits**
- **The security inherent in association with a company established over half a century**
- **Convenience of working in downtown New York City near all local and commuting transportation facilities.**

Please write complete details preliminary to confidential interview to:

MR. MARTIN COYNE

The M. W. KELLOGG Co.

225 Broadway New York 7, N. Y.

STRUCTURAL DESIGNERS

Positions available for qualified men (prefer CE or AE degree) with experience on industrial buildings, bridges, pressure vessels or steel plate details.

Unusual opportunities exist with our well established firm in connection with the design of a variety of engineering projects including bridges, buildings, supersonic testing facilities and other heavy construction.

SVERDRUP & PARCEL, INC.

Consulting Engineers

Est. 1928

915 Olive, St. Louis 1, Mo.

California Calling ENGINEERS

A better job, a better life, a better future can be yours in California—at Lockheed Aircraft Corporation.

On the job, you enjoy increased pay; fine, modern working conditions; association with top men in your profession—men who have helped build Lockheed's reputation for leadership.

Off the job, you live in a climate beyond compare—where outdoor living can be enjoyed the year around.

In addition, Lockheed's production rate and backlog of orders—for commercial as well as military aircraft—insures your future.

TO ENGINEERS IN NON-AERONAUTICAL FIELDS

The step up to Aircraft Engineering isn't as steep as you might expect. Aircraft experience isn't necessary. Lockheed takes your experience, your knowledge of engineering principles, your aptitude and adapts them to aircraft work in its Engineer Training Center.

You learn to work with closer tolerances. You become more weight-conscious. You may attend classes in the Training Center for three days—or six weeks. It depends on your background. But, always, you learn at full pay.

NOTE TO ENGINEERS WITH FAMILIES:

Housing conditions are excellent in the Los Angeles area. More than 40,000 rental units are available. Thousands of homes have been built since the war; huge tracts are under construction now. You will find the school system as good—from kindergarten to college.

Send today for free, illustrated brochure describing life and work at Lockheed in Southern California. Use handy coupon below.

Mr. M. V. Mattson, Empl. Mgr., Dept. CE-8

LOCKHEED

AIRCRAFT CORPORATION, Burbank, Calif.

Dear Sir: Please send me your brochure describing life and work at Lockheed.

My name _____

My address _____

My city and state _____

My occupation (type of engineer) _____

Positions Announced

Corps of Engineers. Available positions for engineers in Keflavik, Iceland, include the following: Construction engineer specializing in underground utilities and soils grading at a yearly salary of $7,040; structural engineer at $7,040; general engineers to review and estimate plans prepared by architects and engineers at $8,360; and construction engineer in the Chief Engineering Reports Branch, at $5,060. There are no accommodations for families. However, there is no charge for quarters, meals are inexpensive, and a 10 percent differential over salary is paid. Interested applicants should communicate or apply for application forms to the Personnel Branch, New York District, Corps of Engineers, U.S. Army, 80 Lafayette Street, New York, N.Y.

State of Illinois, Division of Waterways. Announcement is made of two positions for graduate engineers, with at least 5 to 10 years' experience in structural engineering, capable of assuming responsibility in concrete and structural steel design. Address inquiries to the State of Illinois, Division of Waterways, 201 West Monroe Street, Springfield, Ill.

Engineer Center, Fort Belvoir. Openings for the position of construction inspector, structural engineer, and engineering draftsman at a yearly salary of $4,205 are now available at Fort Belvoir, Va. Other openings are for carto-photogrammetric Aid and Bridge Engineer at a yearly salary of $3,410, and civil engineer at a yearly salary of $5,060. The application for federal employment, standard form 57, must be obtained from a Civil Service Office or Department of the Army Civilian Personnel Office, and mailed or presented in person to the Civilian Personnel Branch, Employee Utilization Section, Building 211, Room 200A, The Engineer Center, Fort Belvoir, Va.

Non-ASCE Meetings

International Association for Bridge and Structural Engineering. The fourth congress of the International Association for Bridge and Structural Engineering will be held at Cambridge and London, England, from August 25 to September 5. Further information may be obtained from the Secretary of the IABSE, Swiss Federal Institute of Technology, Zurich, Switzerland.

UPADI. A meeting of the UPADI (Union Panamericana de Asociaciones de Ingenieros) will be held in New Orleans, La., August 26–30. The UPADI special committee of United States engineers appointed to work out final plans for the meeting consists of J. M. Todd, chairman; E. A. Pratt, vice-chairman; and S.E. Reimel, secretary.

International Symposium on the Chemistry of Cement. The third International Symposium on the Chemistry of Cement organized jointly by the Building Research Station of the Department of Scientific and Industrial Research, and the Cement and Concrete Association, will be held in London England, from September 15 to 20. Further information is available from the Division of Building Research of the National Research Council, Ottawa, Canada.

American Institute of Electrical Engineers. The Pacific General Meeting of the American Institute of Electrical Engineers will convene at the Hotel Westward Ho, in Phoenix, Ariz., from August 19 to 22.

Public Works Congress. Headquarters for the 1952 Public Works Congress and Equipment Show of the American Public Works Association will be the Shrine Convention Hall in Los Angeles, Calif. The dates are August 24–27.

CONSTRUCTION MEN

Technical . . . Mechanical
For Foreign Assignments on Airport Construction

GOOD PAY

18 mo. Contract, Vacation allowances, Free board & room

NOW OPEN:

TOP CONSTRUCTION MANAGER
FOREIGN BUSINESS MANAGER
SUPERINTENDENTS & CRAFT FOREMEN
SR. CIVIL ENGR (soils)
SAFETY ENGINEER
WELDER
(Heavy duty mechanic, Equip. maint)
BODY, RADIATOR & FENDER MAN
PIPEFITTER-PLUMBER
MECHANIC (Heavy-duty Diesel)
OILERS (Lubrication, Fuel & service)

Interviews arranged in New York City or Los Angeles.

Submit Resumé and references:

FLUOR CORP. Ltd.
176 Broadway, New York, N.Y.
or
Rexall Square, P.O. Box 11456
Briggs Sta., Los Angeles, Cal.

Now Available

MANUAL OF PROFESSIONAL PRACTICE

Compiled by the ASCE Committee on Private Engineering Practice. Issued as No. 29 in the Manual of Engineering Practice series, this replaces Manuals 5 and 6 which are no longer available.

Articles covered in this Manual include Public Service and Governmental Employment; Contracts for Service; Classification of Engineering Services; Bases for Making Charges; Overhead; Re-use of Plans; and Estimating Fees for Professional Engineering Services.

Price $1.00
(50% discount to members)

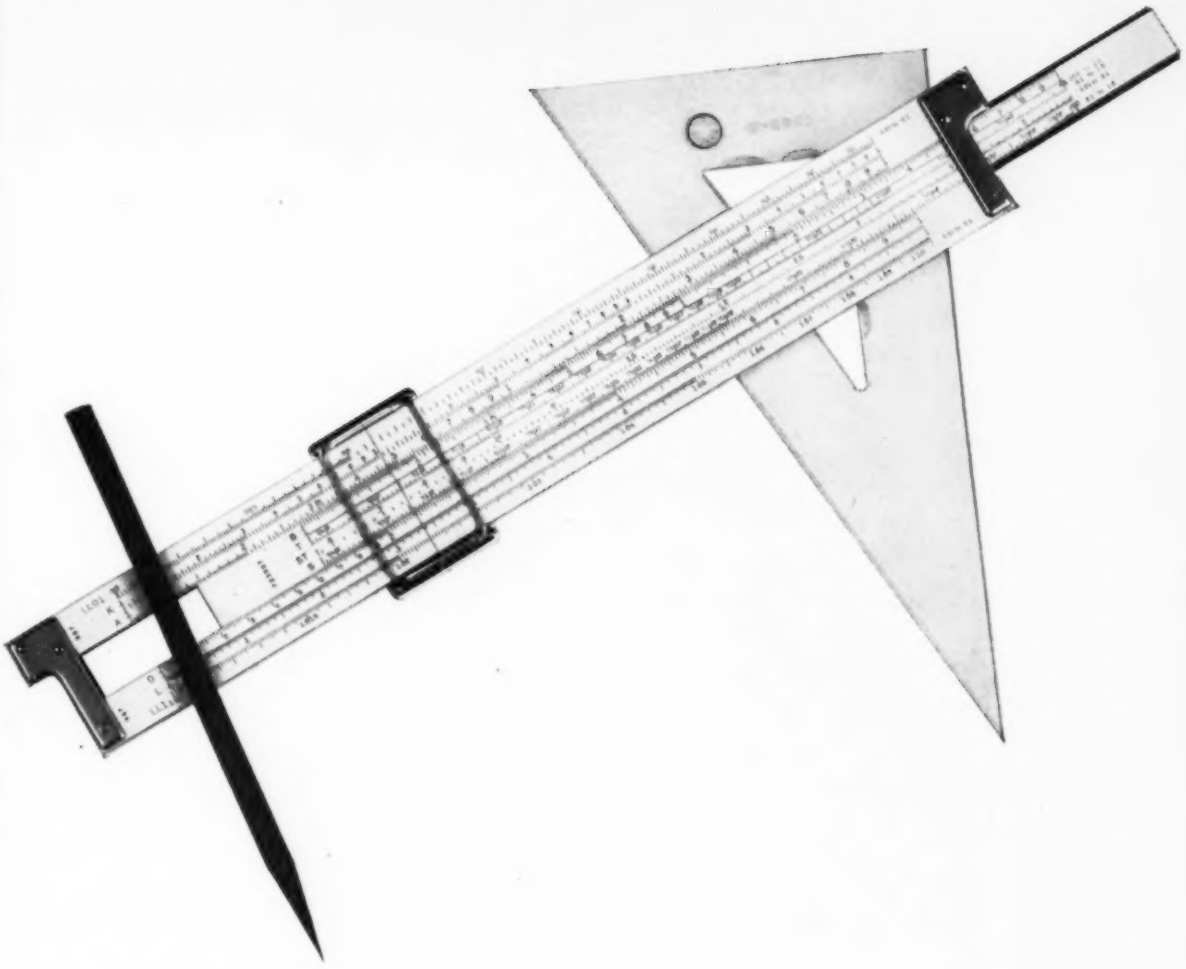
American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.

Please send . . . . . copies of Manual No. 29.
Enclosed is check (or money order) in the amount of $ . . . . . .
I am (not) a member.

Name . . . . . .

Street . . . . . .

City . . . . . State . . . . . .



You'll find classmates—and a future—at Boeing!

Men from more than 120 top engineering schools are building rewarding careers at Boeing. So chances are, you'd be working with some of your classmates here. And you'd be a member of an Engineering Division that has earned world-wide renown for its trail-blazing contributions to both military and civil aviation.

If that's the kind of engineering prestige you'd like to enjoy, look into Boeing opportunities. This company has been growing steadily for 35 years. It provides the finest research facilities in the industry. It offers you work on such exciting projects as guided missiles and the fastest known bomber in the world: the B-47 six-jet medium bomber, as well as the still-classified B-52 eight-jet heavy bomber.

There are opportunities at Boeing for experienced and junior engineers in all fields, for aircraft

- **DESIGN**
- **RESEARCH**
- **DEVELOPMENT**
- **PRODUCTION**
- **TOOLING**

also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

You can work in Seattle, in the Pacific Northwest, or in Wichita, Kansas. Boeing provides a generous moving and travel allowance, gives you special training, and pays a good salary that grows with you.

You'll be proud to say, "I'm a Boeing engineer!"

Write today to the address below, or use the convenient coupon.

JOHN C. SANDERS, Staff Engineer—Personnel
Dept. S-8
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name _____

Address _____

City and State _____

BOEING

RECENT BOOKS

Modern American Engineers

Brief biographies of twelve contemporary engineers picked from widely divergent phases of professional activity comprise Modern American Engineers, by Edna Yost. Although no effort was made to select the most distinguished men, measured by any criteria of contribution to advancement of the profession and of civilization, each one easily ranks among the outstanding engineers of our time. The stories are such as to interest readers of all ages. Each had a consuming intellectual curiousity, tenacity of purpose, and great capacity for hard work. All seized opportunities available to them. None was overly concerned about "security." Publication of the book in 1952 is timely, with the Centennial of Engineering in America being celebrated this year. (J. B. Lippincott Co., East Washington Square, Philadelphia, Pa., 1952. 182 pp., $2.50.)

Untergrundbahnen und Ihre Einsatzgrenzen

This book by Rudolf Berger on the economic planning and utilization of underground rapid transit discusses the factors involved in the establishment and extension of subway rapid-transit systems from both the technical and economic points of view. An analysis is made of the systems and their operation in 20 large cities, including a discussion of the lower and upper limits for subway rise and expansion. Brief descriptions and maps are appended. (Verlag von Wilhelm Ernst & Sohn, Hohenzollerndamm 169, Berlin-Wilmersdorf, Germany, 1951. 99 pp., D.M. 9.50.)

Bibliographic Survey of Corrosion—1946-1947

The engineering and publishing staffs of the National Association of Corrosion Engineers have compiled this comprehensive bibliography from the major abstracting services in the field as well as from specialized indexing sources. The items are arranged according to a classification scheme devised by the NACE based on the careful subdivision of eight major sections—general, testing, corrosion types and influencing factors, corrosive environments, preventive measures, materials of construction, equipment, and industries. An author index, a subject guide, and notes on how to secure copies of the articles indexed, are also given. (National Association of Corrosion Engineers, 919 Milam Building, Houston 2, Texas (Publication No. 51-1) 1951. 288 pp., $9.)

(The) Displacement Method of Frame Analysis

This book by G. P. Manning, describes the method of frame analysis used in practice by the author for fifteen years, which enables numerical solutions to be obtained with sufficient accuracy by the use of a slide-rule. The method is applicable to continuous beams and frames of any shape, whether subjected to sway or not. Examples are given of a design of a number of types of structures, and tables give the factors for a variety of members. Diagrams are freely used to illustrate the method of analysis. (Concrete Publications Limited, 14 Dartmouth St., London, S.W.1, England, 1952. 120 pp., 9s.)

Fluid Flow in Pipes

A summary of modern theory in the flow of liquids and gases through piping and ducts is given by Clifford H. McClain in this volume, which deals in a concise, simple manner with viscosity, friction, turbulence, steam-line flow, head, and other factors influencing the over-all result. Dimensional relationships are emphasized. Practical applications and detailed worked-out examples help to clarify the handling of piping problems. (The Industrial Press, 148 Lafayette St., New York, 1952. 123 pp., $3.)

(An) Introduction to the Engineering Profession

John G. McGuire and Howard W. Barlow present an occupational study of the principal fields of the engineering profession, and a discussion of the nature of engineering, aptitudes, requirements, preparatory courses, kinds of work involved, and prospects in the field. A section is devoted to illustrative problems in the various branches, primarily for use in a course on engineering problems, but also intended to show what the engineer must solve and how he goes about it. (Addison-Wesley Press, Inc., Kendall Square Building, Cambridge, 42, Mass., second ed., 1951. 260 pp., $5.)

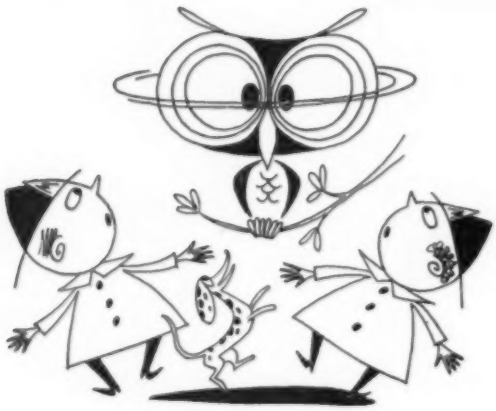
Short Cuts in Concrete and Steel Design

Graphs and tables are provided by the author, Fred C. Whitney, for a variety of structural elements—slabs, beams, columns, brackets, plates, etc.—by means of which the designer can rapidly establish satisfactory solutions for a wide range of structural conditions and requirements. A few special topics such as chimney footings, bin plates, and rings are also included. (Fred C. Whitney, 16502 Ward Avenue, Detroit 35, Mich., 1951. 84 pp., $3.50.)

Tractors and Their Power Units

Intended both as a college text and as a reference work for the practical man, this book, *Tractors and Their Power Units* by E. L. Barger and others, covers the principles of the internal-combustion engine, tractor fuels, the special characteristics of the tractor power unit, the mechanics of the chassis, and the auxiliary elements involved. Tractor tests and performance, maintenance and repair, and power cost estimating are also discussed. A chapter is devoted to the operator's comfort, convenience and safety. (John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1952. 496 pp., $6.50.)

Head turns all the way around



Nozzle direction may be changed easily and at any time by simply loosening the bolts in the swivel flange and turning the head . . . The number and size of nozzle outlets can be changed by replacing the head, and without shutting off the water.

MATHEWS
HYDRANTS

Made by R. D. Wood Company Public Ledger Building, Independence Square, Philadelphia 5, Pa. • Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Mathews Modernized Hydrants . . . Tops in Convenience and Dependability Compression-type valve prevents flooding • Head turns 360° • Replaceable head • Nozzle sections easily changed • Nozzle sections raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be lubricated • All working parts contained in barrel • A modern barrel makes an old Mathews good as new • Available with mechanical joint pipe connections

Air Pollution

The Proceedings of the United States Technical Conference on Air Pollution consists of nearly 100 papers presented at the 1950 conference by authorities from the government services, research organizations, and industry under sponsorship of the Interdepartmental Committee on Air Pollution. In order to coordinate the information effectively, seven panels were established as follows: air pollution in relation to agriculture; analytical methods and properties; equipment for the collection or prevention of formation of contaminants; health considerations; instrumentation for size and concentration determinations, etc.; legislation; and meteorological aspects. (McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N.Y., 1952. 847 pp. $12.50.)

American Pipe Lines

A thorough effort to present and analyze the salient factors involved in the economic and regulatory status of pipe lines constitutes *American Pipe Lines* by George S. Wolbert, Jr. In two parts, the book opens with a report on the historical, economic, and technical development of pipe lines, including a discussion of the specific issues relating to industry rate and service requirements. The second part surveys existing legal and administrative remedies designed to cope with the problems described in Part I. The influence of the I.C.C. is examined carefully. (University of Oklahoma Press, Norman, Okla., 1952. 179 pp., $3.50.)

(The) Elements of Soil Mechanics in Theory and Practice

Four public lectures on the elements of soil mechanics are given in this book by Kevin L. Nash. They are designed to give a simple and concise account of the aims, scope, and methods of the science of soil mechanics. The first lecture deals with the development of the science and the general nature of soils; the next two deal with specific technical details, such as densities, shear strength, stability of slopes; and the final lecture discusses the various methods of soil stabilization. (Constable & Company, Ltd., London, 1951. 110 pages, 9s.)

Modern Bridge Construction

Intended as a reference work for the practicing civil engineer as well as a text for students, this work (second edition) by F. Johnstone Taylor deals with the following classes of bridges: masonry bridges; small bridges of steel or timber; trussed girder bridges; steel bridges of various types, particularly the steel arch and suspension; swing, bascule; and vertical-lift bridges; reinforced-concrete. Erection, fieldwork, foundations, and welding in bridge construction are briefly covered. The necessary mathematics has been kept as simple as possible. (The Technical Press, Ltd., London, 331 pp., 30s.)

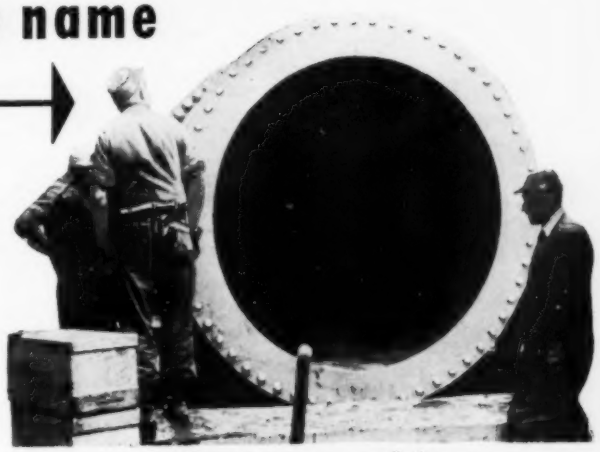
Industrial Buildings

All informative material on industrial buildings printed in the "Architectural Record" during the years 1940 to 1949 is reproduced in this volume compiled by Kenneth Reid. A wide range of building types is surveyed—newspaper plants, bottling plants, power stations, warehouses, factories, laboratories, etc. There are also numerous articles on basic technical details concerning lighting, heating and ventilating, plumbing, plant layout, etc., applicable to many fields. Section III includes all the Time-Saver Standards published during the decade covered. (F. W. Dodge Corp., New York, 1951. 542 pp., $9.)

Theorie et Pratique Des Travaux a La Mer

This comprehensive volume by Marcel Blosset, covers wave and tidal action and their use as energy sources, discusses the general principles of concrete structures and sheet piling, and details the construction of harbor protection works, docks and quays, locks and drydocks, lighthouses, and other maritime structures. Shipyards and ways, dikes, canals, and terminals are dealt with, and the use of hydraulic models is discussed. The topics of navigation methods, hydrography, and port traffic are also briefly treated. (Editions Eyrolles, 61 Boulevard Saint-Germain, Paris (5e), 1951. 647 pp., Ffrs 3950.)

WARREN
is the name



for everything you want in cast iron pipe!

Specify **WARREN**
CAST IRON PIPE...
AND BE SURE!

Durable, long-lasting . . . made with the proper crushing, beam, shock and bursting properties for maximum strength. Desirable qualities in any pipe, you'd say?

Warren Cast Iron Pipe stays in service . . . its lasting qualities have been proved by excavated pipe that has been under ground for 93 years . . and *still* in good condition!

Made in all sizes from 2" to 84" with all types of joints. Special castings in medium to heavy weights in many non-standard patterns to help you solve those problems that require "different" installations. Also available in gray iron and Meehanite iron.

SPECIFY WARREN CAST IRON PIPE and be sure.

Warren FOUNDRY & PIPE CORP.
55 LIBERTY STREET, NEW YORK 5, N. Y.

Bell & Spigot Pipe • Flange Pipe • Mechanical Joint Pipe
Flexible Joint Pipe • Short Body Bell & Spigot Specials

WARREN PIPE CO. OF MASS. INC. 75 FEDERAL ST. BOSTON, MASS.
96 Years of Continuous Service

Centennial Convention of ASCE
Conrad Hilton Hotel, Chicago, Ill., Sept. 3–13, 1952

(*Please Print*)

Name.....

Street.....

City.....Zone.....State.....

MAIL TO:
Conrad Hilton Hotel
Reservation Manager
Chicago 5, Ill.

Please reserve for my occupancy the following hotel accommodation:

Double.....Single.....

Double—twin beds.....Suite.....

Other.....

Date and hour of arrival.....

Date of departure.....

PREPRINTS AVAILABLE
NEW ORLEANS CONVENTION
MARCH 1952

Price—$0.25 each net prepaid

Preprint Number	Title and Author	Division	Indicate quantity required
1	Highway Bridges on Deep Foundations Louis C. Duclos, 24 pages	Highway	☐
2	A Comprehensive Report on the Arkansas-Red-White Basins J. B. Lampert, 16 pages	Waterways	☐
3	Highway Embankment on Yielding Subsoil H. L. Lehmann, 40 pages	Soil Mechanics	☐
4	Welded Frame Multi-Story Buildings Boyd S. Myers, 16 pages	Structural	☐
5	Arkansas-White-Red Basins Inter-Agency Committee L. W. Prentiss, 16 pages	Waterways	☐
6	Port of Lake Charles, La. Elmer E. Shutts, 24 pages	Waterways	☐
7	Major Pipe Line Crossings of the Mississippi River P. H. Timothy, 16 pages	Construction	☐
8	Construction of the New Orleans Union Passenger Terminal C. S. Wallace, 12 pages	Construction	☐
9	Foundation Problems in the New Orleans Area Herman A. Huesmann, 16 pages	Soil Mechanics	☐
10	Wave-Wash Control on Mississippi River Levees Rudolf Hertzberg, 24 pages	Waterways	☐
11	The Deep Water Entrance to Lake Maracaibo, Ven. E. F. Robinson, 36 pages	Waterways	☐
12	Construction of Morganza Control Structure D. L. White, 24 pages	Construction	☐
13	The Passes of the Mississippi River W. C. Cobb, 32 pages	Waterways	☐
14	Property Surveys in the City of New Orleans F. C. Gandolfo, Jr., 8 pages	Surv. & Mapping	☐
15	Drainage in Louisiana—Authorized and Financed under State-Wide Law Byron P. Lyons, 8 pages	Hydraulics	☐
16	Foundation Investigations for Offshore Drilling Structures in the Gulf of Mexico Bramlette McClelland, 36 pages	Soil Mechanics	☐
17	Sanitary Engineering Activities in the Atomic Energy Commission J. A. Lieberman, 24 pages	Sanitary Eng.	☐
18	Louisiana's First-All-Welded Continuous Overpass Walter E. Blessey, 40 pages	Structural	☐
19	Estimating Peak Rates of Run-off-Bridge and Culvert Design Carl F. Izzard, 16 pages	Hydraulics	☐
20	Prototype Hydraulic Investigation Program—TVA (Tabulated) Rex A. Elder, 20 pages	Hydraulics	☐
21	Tranquil Flow Through Open Channel Constructions Carl E. Kindsvater and Rolland W. Carter, 56 pages	Hydraulics	☐
22	The Proposed Mississippi River Parkway J. Lester White, 12 pages	City Planning	☐
23	Foundation and Settlement Investigation—Sulphur Storage Vats J. Bres Eustis, and Irven E. Hanson, 20 pages	Soil Mechanics	☐
24	Traffic Relief Through Modernized Management D. Grant Mickle, 16 pages	Joint C.P. & ITE	☐
25	Topographic Mapping in Louisiana Gerald FitzGerald, 12 pages	Surv. & Mapping	☐
26	Problems—Major Pipe Line Crossings, Mississippi River R. P. Gregory, 16 pages	Construction	☐
27	The Role of the Engineer in Traffic Planning for Metropolitan Areas Lloyd M. Braff, 12 pages	Joint C.P. & ITE	☐
		TOTAL	☐

American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.

Please send.....copies of New Orleans Convention Preprints as checked in above list at $0.25 each. Enclosed is check (or money order) in the amount of $.....

Name.....

Street.....

City.....State.....

PREPRINTS AVAILABLE
DENVER CONVENTION
JUNE 1952

Price—$0.25 each net prepaid

Preprint Number	Title and Author	Division	Indicate quantity required
28	Application of Flow Analysis to Vaned Elbows Edw. Silberman, 20 pages	Eng. Mechanics	☐
29	Structural Design of University of Wyoming Field House Milo S. Ketchum, 16 pages	Structural	☐
30	Timber Construction, Expansible Industry, For Emergency Needs M. W. Jackson, 12 pages	Structural	☐
31	Stabilization of Soil by Silt Injection Method Geo. E. Johnson, 28 pages	Soil Mechanics	☐
32	Foundation Exploration—Denver Coliseum Ralph B. Peck, 24 pages	Soil Mechanics	☐
33	Foundation Problems at Trenton Dam, Nebraska Ellis Armstrong, 36 pages	Soil Mechanics	☐
34	Channel Stabilization—Missouri River Raymond L. Huber, 16 pages	Waterways	☐
35	Correlation of Runway Design Procedure Robert Horonjeff, 24 pages	Air Transport	☐
36	Denver-Boulder Turnpike, Colorado Roderick L. Downing, 16 pages	Highway	☐
37	Power Features—Colorado—Big Thompson Project S. Denton and H. L. Neve, 40 pages	Power	☐
38	Novel Features, Diversion and Outlet, Boysen Dam, Wyoming Ralph W. Whinnerah, 16 pages	Power	☐
39	Canal and Locks at Chain of Rocks, Mississippi River A. F. Griffin, 16 pages	Waterways	☐
40	Upper Minneapolis Harbor, St. Anthony Falls, Minn. L. G. Yoder, 24 pages	Waterways	☐
41	Surveying and Mapping in Alaska Gerald FitzGerald, 12 pages	Surv. & Mapping	☐
42	Algae Responsible for Taste and Odor, in Public Water Supplies George J. Turre, 8 pages	Sanitary Eng.	☐
43	Denver's Master Street Plan John S. Marshall, 16 pages	City Planning	☐
44	Traffic Engineering and Mass Transportation Henry A. Barnes, 8 pages	City Planning	☐
45	Construction of Granby Dam, Colorado Ed. H. Honnen, 8 pages	Construction-Structural	☐
		TOTAL	☐

American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.

Please send.....copies of Denver Convention Preprints as checked in above list at $0.25 each. Enclosed is check (or money order) in the amount of $.....

Name.....

Street.....

City.....State.....

HERE'S THE STRONGEST BRONZE

HY-TEN-SL

A Bronze as Strong as Nickel Steel

TRADE-MARK

Grade of HY-TEN-SL	1AA	1A	1	2	3	4
TENSION				(Minimums)		
Ultimate tensile strength lbs. per sq. in.						
Sand Cast	125,000	115,000	108,000	100,000	90,000	85,000
Rolled 1" and under	.....	120,000	110,000	105,000	95,000	85,000
Rolled or Forged, over 1"	.....	115,000	108,000	100,000	90,000	85,000
Yield Point (divide: method)						
Sand Cast	95,000	75,000	60,000	55,000	45,000	40,000
Rolled 1" and under	.....	75,000	63,000	60,000	50,000	45,000
Rolled or Forged, over 1"	.....	75,000	65,000	60,000	50,000	45,000
Elongation in 2" —%						
Sand Cast	10	12	14	15	20	25
Forged or Rolled	.....	12	13		15	20
Reduction in area—%						
Sand Cast	.....	12	14	15	20	25
Forged or Rolled	.....	12	13		15	20
COMPRESSION						
Yield Point— lbs. per sq. in.	70,000	65,000	58,000	50,000	40,000	35,000
Permanent Set at 100,000 lbs. per sq. in. (max.)	.015	.020	.030	.050	.080	.125
Brinell hardness, No.	250	240	220	200	175	150

List of U. S. Government Specifications Covering HY-TEN-SL Bronze

ARMY
Forgings, Rolled Rod QQ-B-721 Class B
Castings...QQ-B-726 Class B and C

NAVY
Forgings and Rolled Rod 46B15d Class B
Castings, Aluminum-manganese Bronze 46B29

WATERTOWN ARSENALS and OTHER ARMY
Castings WXS-5
Forgings and Rolled Rod.....WXS-2

NAVAL GUN FACTORY
Washington Navy Yard
Castings—Trunnion Metal.....O.S.530

AIRCRAFT
See Navy and Army (above).

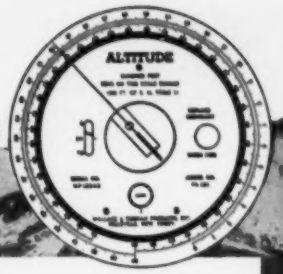
Send for 46 Page "Text Book"

AMERICAN MANGANESE BRONZE COMPANY

4716 RHAWN ST., HOLMESBURG, PHILADELPHIA 34, PA.

Established 1909

RUGGED COUNTRY *Requires* RUGGED ALTIMETERS



Whether you're surveying rough terrain or gentle slopes, it's nice to know that your precision altimeters are rugged and durable enough to withstand severe shocks and vibrations. This security is yours with W&T Sensitive Altimeters.

Consider particularly the W&T Sensitive Altimeter Type FA-181 — an instrument in which construction and precision meet the exacting requirements of military service. The Type FA-181 is aluminum cased and has a latched metal lid for protection under all climatic conditions. Several standard ranges are available. The —1000 to 6000 foot range, for example, is readable to one foot — with sensitivity of one part in 8000. A desiccant (with a condition indicator) is included to absorb moisture which may enter the case. The Altimeter is compensated for temperature changes and readings do not require correction.

Important features of the FA-181 as well as other W&T Altimeters include:

SELF BALANCING PRINCIPLE. No adjustment or setting is required. There is no lag.

CALIBRATION. Scales are individually drawn for each mechanism and require no correction.

DURABILITY. The mechanism is simple and is shock-proof mounted within the instrument case.

PERFORMANCE. W&T Altimeters rival the accuracy of the finest laboratory standards and performance stated in the specifications is guaranteed.

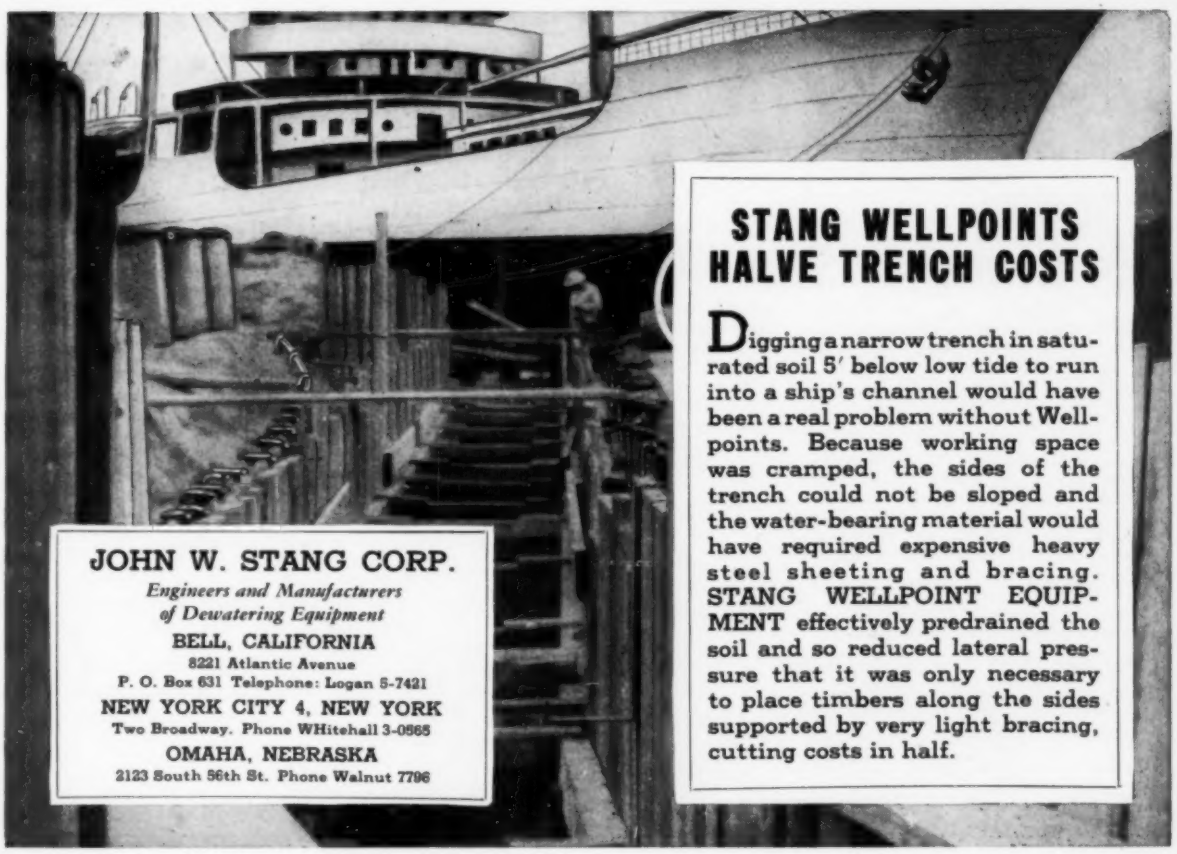
An altimetry manual is furnished with every W&T Altimeter. Also available is the W&T Palmer Altirule, a graphic computer for calculating elevations of field stations without computation when using the Two Base Method of Precise Altimetry.

WALLACE & TIERNAN PRODUCTS, INC.

ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS

Belleville 9, New Jersey • Represented in Principal Cities

A-91



STANG WELLPOINTS HALVE TRENCH COSTS

Digging a narrow trench in saturated soil 5′ below low tide to run into a ship's channel would have been a real problem without Wellpoints. Because working space was cramped, the sides of the trench could not be sloped and the water-bearing material would have required expensive heavy steel sheeting and bracing. STANG WELLPOINT EQUIPMENT effectively predrained the soil and so reduced lateral pressure that it was only necessary to place timbers along the sides supported by very light bracing, cutting costs in half.

JOHN W. STANG CORP.

Engineers and Manufacturers of Dewatering Equipment

BELL, CALIFORNIA
8221 Atlantic Avenue
P. O. Box 631 Telephone: Logan 5-7421

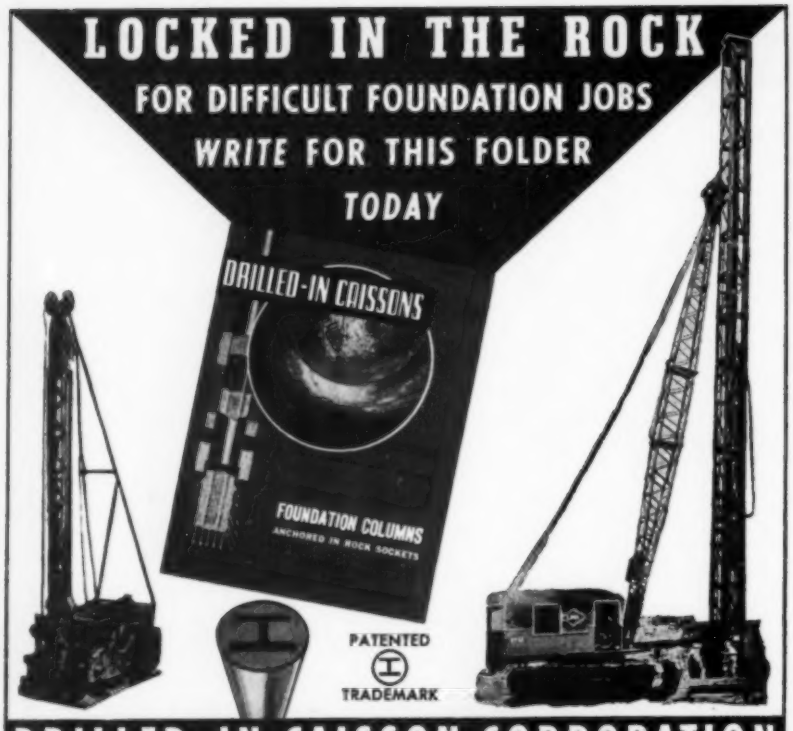
NEW YORK CITY 4, NEW YORK
Two Broadway. Phone WHitehall 3-0565

OMAHA, NEBRASKA
2123 South 56th St. Phone Walnut 7796

LOCKED IN THE ROCK

FOR DIFFICULT FOUNDATION JOBS

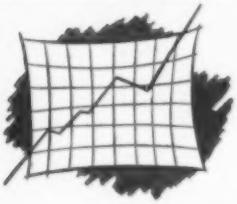
WRITE FOR THIS FOLDER TODAY



DRILLED-IN CAISSON CORPORATION

2 PARK AVENUE, NEW YORK 16, N. Y. • OREgon 9-2082

Affiliated with SPENCER, WHITE & PRENTIS, NEW YORK • WESTERN FOUNDATION CO., NEW YORK



COSTS RISING?

BIDDING TIGHT?

. . . You need CONSTRUCTION COST CONTROL

Written by construction men, and containing sections on: Classification of Construction Cost Accounts; Distribution of Costs; Control of Costs; Financing the Construction, and Taxes.

CONSTRUCTION COST CONTROL IS a Practical answer to your cost problem.

Well illustrated and supported by charts and specimen accounting forms, this authoritative 97-page, 8½ x 11, sturdily bound book covers the complete cycle of estimating, accounting, distributing and analyzing of all operational and overhead costs. A practical and easily applied system is fully outlined.

Included are sections on: PRELIMINARY ESTIMATING, BUDGETING, CLASSIFICATION OF CONSTRUCTION COST ACCOUNTS, DISTRIBUTION OF ACCOUNTS, CONTROL OF COSTS, TIME AND MOTION STUDIES, FINANCING AND TAX PROBLEMS.

Sent postpaid to ASCE Members—$4.00
To non-members—$5.00
To ASCE Student Chapters in quantities of 10 or more—$3.00 each
To colleges for textbook use in quantities of 10 or more—$3.00 each

American Society of Civil Engineers
33 West 39th St., New York 18, N. Y.

Please send....copies of CONSTRUCTION COST CONTROL.

Enclosed is check (or money order) in the amount of $.....
(I am).....(I am not).....a member of ASCE.

Name.....

Firm.....

Street.....

City.....State.....

News of Engineers

(*Continued from page 101*)

E. P. Swatek, chief design engineer of the contracting division of the Dravo Corp., has been awarded the Fuertes Graduate Medal by the Cornell University School of Engineering. An alumnus of the class of 1940, he holds the degree of bachelor of science in civil engineering. The award was presented to Mr. Swatek in recognition of his authorship of a paper on the reconstruction of Lock 2 in the Monogahela River at Braddock, Pa. Mr. Swatek has been associated with Dravo since 1940.

E. P. Swatek

Fred S. Childs, member of the firm of Bogert-Childs Engineering Associates, New York, N.Y., has been reappointed a member of the New Jersey State Board of Professional Engineers and Land Surveyors.

Sigmund L. Levin, former associate editor of *The Engineer,* is now associated with Pereira and Luckman, architects and engineers of Los Angeles, Calif.

S. S. Steinberg, dean of the University of Maryland College of Engineering, has been presented with a Special Certificate of Merit by Secretary of Labor Tobin. The accompanying citation commended Dean Steinberg "for his outstanding contribution as chairman of the Committee on Education of the President's Conference on Industrial Safety, in grateful appreciation for his performance of duties important to the public interest."

Raymond Davis Wygant, formerly field representative with the Housing and Home Finance Agency, in Washington, D.C., has received an appointment as housing consultant with the Division of Health, Welfare and Housing of the Institute of Inter-American Affairs, a U.S. Government Point IV agency. Mr. Wygant is now stationed in Quito, Ecuador.

Robert B. Moorman, professor of civil engineering at the University of Missouri since 1935, will become chairman of Syracuse University's department of civil engineering in September.

Lloyd B. Reid, traffic commissioner for the City of New York and engineering consultant on traffic parking and transportation, has announced the opening of a New York office, in addition to his headquarters in Detroit, Mich.

Frederick J. Sanger, associate professor of civil engineering at Worcester Polytechnic Institute, Mass., has been promoted to the rank of professor of civil engineering.

If you are
an engineering executive
engineer, teacher or student —
You have a stake
in the Engineering Profession

The SECOND MILE

by W. E. Wickenden
["Whosoever shall compel thee to go one mile—go with him twain."]

Eptomizes for you—
your staff
your students

1. Ideals for the professional life
2. Rules for the engineer to live by
3. What engineers must do to make engineering a profession

5000 words of simple useful philosophy about the needs and aspirations of the Engineer. An understanding of "The Second Mile" is essential to professional maturity.

Single copy 15¢ 15 or more 10¢ a copy

Engineers' Council for Professional Development
29 West 39th Street
New York 18, N. Y.

HYDROLOGY HANDBOOK

SOCIETY MANUAL NO. 28
192 pages

Authoritative reference in a growing field

Thirty-three specialists have collaborated to present up to date coverage on

Precipitation
Infiltration
Run-Off
Evaporation and Transpiration
Ground Water Storage

Continuous demand for this manual evidences its wide acceptance by teachers and practicing engineers.

Use this handy order blank

☐ . . . copies paper covers (non members) $3.00 each
☐ . . . . . (members) 1.50 each
☐ . . . . cloth . . (non members) 4.00 . .
☐ . . . . . (members) 2.50 . .

Payment is enclosed herewith

Name . . . . . .
Address . . . . . Grade Membership . . . .
City . . . . . .

Applications for Admission to ASCE, June 14–July 12

Applying for Member

HOMER NOBLE BARTLETT, Brooklyn, N. Y.
WILLIAM CHELSE BOYNTON, Seattle, Wash.
FRANK HARVIE CLOUGH, South Pasadena, Calif.
KENNETH DEAN CUNNINGHAM, Pittsburgh, Pa.
EDMUND PETER ERWEN, Pasco, Wash.
RICHARD EVAN FISHER, Honolulu, T. H.
WOODFORD MCKEE GREEN, SR., Greenville, S. C.
JAMES HAROLD HANSEN, New York, N. Y.
RAYMOND CARL HERNER, Indianapolis, Ind.
CARL JACOB HOFFMAN, Denver, Colo.
WILLIAM LEO HYLAND, Boston, Mass.
HOMER CLARENCE INNIS, JR., Corpus Christi, Tex.
ALLEN FRANKLIN JONES, Harrisburg, Pa.
NORMAN JACKSON MAYNARD, Ashland, Ky.
DONALD ELIJAH PHILLIPS, Kansas City, Mo.
THOMAS LEROY PIERCE, Wilmington, Del.
JAMES JOHN ROSE, Albuquerque, N. Mex.
FRANK CRAIN SCHLEICHER, Maracaibo, Venezuela.
ROBERT SHAMA, Caracas, Venezuela.
VERNON WILLIAM SMITH, SR., Atlanta, Ga.
SAMUEL FATIO STEPHENS, Richmond, Va.
BATTAILLE HARRISON WADE, Baton Rouge, La.
SHIH SHEE WANG, Taiwan, China.
HARVILL EWING WELLER, Vicksburg, Miss.
ROBERT MASON WILKERSON, Los Angeles, Calif.
WALTER CARL YAEGER, Wauwatosa, Wis.
FREDERICK WILLIAM ZIES, Baltimore, Md.

Applying for Associate Member

DAVID LEWIS ADAIR, JR., Houston, Tex.
WILLIAM JOSEPH BARDIN, San Jose, Calif.
WILLIAM ALLMOND BARR, JR., Wilmington, Del.
SAMUEL ABRAM BOCK, Denver, Colo.
ARTHUR STOVALL BOOTH, Atlanta, Ga.
ROLAND WOODROW BROWNE, Los Angeles, Calif.
JAMES HENRY CAMPBELL, Shreveport, La.
FREDERICK LANE CONWAY, New York, N. Y.
JOHN BURTON COURNYN, College Park, Md.
JASON FRANCIS CRAIG, New York, N. Y.
EVERETT JOHN CUPPS, Wichita, Kans.
WALTER EDWARD DINN, New York, N. Y.
WARD MANKER DOBBIN, Cicero, Ill.
ELBERT EDWARD ESMIOL, Denver, Colo.
YOUSSEF EZZELDINE, Cairo, Egypt.
HARRY WERNER FIRMAN, Philadelphia, Pa.
EARL ELMER FLANAGAN, Hastings, Nebr.
JOAO MOREIRA GARCEZ FILHO, Sao Paulo, Brazil.
BRAULIO ENRIQUE GONZALEZ NOVO, Havana, Cuba.
VERNER WILLIAM HAMPTON, Salisbury, So. Rhodesia.
MYO HAN, Denver, Colo.
SAMUEL MAL HILL, JR., Fosters, Ala.
GUS JACOB HUTTO, Charleston, S. C.
ABD-EL-AZIZ ISMAIL KASHEF, Giza, Egypt.
PAUL WILLIAM JENICEK, Tulsa, Okla.
RAUL MARURI DIAZ, Guayaquil, Ecuador.
HOWARD NICHOLS MCLAUGHLIN, SR., San Francisco, Calif.
GEORGE GEOFFREY MEYERHOF, Herts, England.
ROLAND BRICE MOORE, JR., Austin, Tex.
WILLIAM BROOKS MORRIS, Dallas, Tex.
ADOLFO MAYORAL NEGRON, San Juan, Puerto Rico
JOHN BERRY NOLAN, Rolla, Mo.
BHALCHANDRA ANANT PATANKAR, Bombay, India
STUART HERBERT POORE, Richmond, Va.
RICHARD BRADSHAW POTTS, Sacramento, Calif.
RICHARD FURNIVAL PRICE, Saudi, Arabia.
EUGENE ALBERT SCHMIDT, Milwaukee, Wis.
ERVIN SPINDEL, Los Angeles, Calif.
EUGENE JOSEPH TAYLOR, Denver, Colo.
EDWARD EARLE WALTERS, Dallas, Tex.
DOUGLAS JAMES WARDLE, London, England.
EDUARDO RIOMEY YASSUDA, Sao Paulo, Brazil.

Applying for Junior Member

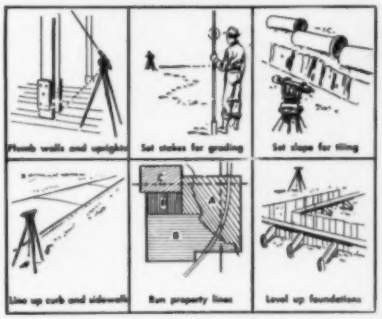
ALFONSO V. CASIMIRO, Boston, Mass.
HERBERT YUAN-SHING CHU, New York, N. Y.
HARLAN GIBSON COLLINS, Hot Springs, S. Dak.
ROBERT GEORGE DENIES, Roanoke, Va.
DONALD ROGERS DUNKER, Prince George County, Md.
MACK LYNN EPPERSON, Oak Ridge, Tenn
ROBERT EDWARD GRIFFITH, Hermiston, Oreg
S.N. GURU RAU, Hirakud, North India.
RICHARD JOHN MADACHY, Patrick Air Force Base, Fla.
JOHN GASPER MASCIONI, New York, N. Y.
WILLIAM FREDERICK MUTSCHLER, Wilmington, Del.
JOSE MANUEL NIEVES-OLMO, Mayaguez, Puerto Rico.
RAMANBHAI DAHYABHAI PATEL, East Lansing, Mich.
HERBERT CHARLES PREUL, Goleta, Calif.
ERNEST RADOCI, Baltimore, Md.
EDWARD NILS REIN, Cambridge, Mass.
WILLIAM SHIRLEY ROGERS, Gary, Ind.
TAJMOHAMMED WALIMOHAMMED SHAIKH, Karachi, Pakistan.
HUA TUAN TEOH, Durham, England.
CHARLES HENRY WAGNER, Portland, Oreg.
NIELS WANG, Boston, Mass.

[Applications for Junior membership from ASCE Student Chapters are not listed.]

White Universal Level-Transit...

most versatile instrument you can own!

Indispensable for these jobs—and many more



ENGINEERS agree: you can do more jobs better — at lower cost — with the White "Universal" Level-Transit. The improved Model 3000 has internal focusing, coated optics, a guarded vertical arc. Plus all the other quality features needed to give you lifetime durability and accuracy. The price: *only $185**, complete with tripod. See your dealer, or write DAVID WHITE COMPANY, 359 W. Court Street, Milwaukee 12, Wisconsin.

DAVID WHITE COMPANY

We offer the most expert REPAIR SERVICE on all makes, all types of instruments.

**Price subject to change without notice.*

7197

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Dryer-Mixer Combination

A SIGNIFICANT DEVELOPMENT in the field of road and street maintenance has just been announced. Named the "Mixall," the machine is a highly portable, one-unit dryer-mixer combination which promises to revolutionize the patching of breaks and failures in both asphalt and concrete roads. For the first time, highway maintenance crews will have available the means for on-the-spot production of the same high-type hot bituminous mix used in highway construction. Designed expressly for towing at normal truck speeds, the Mixall is mounted on a sturdy two-wheel pneumatic tired chassis, with an adjustable towing hitch to accommodate trucks of varying sizes. After being towed to the job site, the machine can be operated without unhitching, or it can be detached from the truck and set in a level position through use of a hydraulic jack-

The Mixall

leg support built into the towing hitch. Versatility in methods of charging the machine is another of its design features. The upper edge of the Mixall's power operated skip is only 14 in. above ground level, making it easy to charge with a wheelbarrow or hand shoveling. The skip discharges the aggregate into a rotary drying drum. Flights around the drum's inner circumference lift the aggregate particles and drop them, repeatedly through a blast of hot gas and flame provided by an oil burner. The force of this heated blast drives off the moisture

removed from the aggregate, exhausting it through twin stacks. This assures that each particle will be thoroughly dried. The drying cycle is set at any predetermined number of drum revolutions; these being indicated on a large revolution counter at the rear of the drum. From the drum, the heated, dried aggregate is chuted into a twin-shaft pugmill. Just as the dryer employs the same principle as used in the largest B-G high-type plants, so does the pugmill operate exactly as do those on the larger plants. The pressure, kneading action offered by this method insures complete and even coating of each aggregate particle. Both drying and mixing can be treated as separate operations or can be coordinated into cycles of equal duration. At the conclusion of the mixing cycle, the entire bottom of the pugmill opens, permitting the mix to fall into a wheelbarrow or directly onto the ground, in the area being patched. Capacity depends upon the type of mix being produced and the amount of moisture to be removed from the aggregate. When hot mix is being produced, where the aggregate is thoroughly dried and brought up to the correct temperature, the capacity ranges up to five tons per hour. The machine can easily produce ten tons per hour of cold mix. **Barber-Greene Company, Aurora, Ill.**

Concrete Cutting Machine

USING A DOUBLE-BONDED, water-cooled diamond cutting blade, the Tri-Line concrete cutter produces a fast, smooth-surfaced cut completely eliminating the cracked, spalled or broken edges experienced in ordinary pavement breaking methods. Powered by a 13 hp, two-cylinder Wisconsin engine, the concrete cutter permits continuous or intermittent cuts on straight or reasonably curved lines, at any desired depth to $6\frac{1}{2}$ in. A double-ended arbor allows cutting on either side of the machine, in places normally inaccessible. Direct acting hydraulic control allows quick, effortless depth-of-cut adjustment. The exclusive three-wheel undercarriage design prevents tilting, thereby eliminating blade bind and excessive blade wear. This tricycle

Three-Wheel Undercarriage Design

design provides maximum maneuverability, permits turning the cutter within its own length without jockeying. Vital engine parts are protected from blade water spray. Water is furnished by a 30 gal tank which may be used when water supply is inconvenient; or, machine may be connected to a hydrant if desired. **Tri-Line Company, 965 Carroll St., Racine Wis.**

Wage Tax Computer

PAYROLL TAX DEDUCTIONS are greatly simplified by a payroll tax computer, which gives direct "window" readings on a single line of accurate F.I.C.A. (F.O.A.B.) and withholding tax deductions. To prevent obsolescence, this wage tax computer is so designed that new-drum charts may be affixed easily. Drums carrying the computing tables are interchangeable for weekly, bi-weekly, monthly or semi-monthly pay periods, each of which can be used in the same computer. A turn of a finger-tip dial rotates a drum within a clear cylinder which reveals correct tax computations for any salary, no matter what the pay period or dependents. Speed of computation is increased over old methods by approximately 50 percent. It is reported errors are reduced approximately 75 percent. Exact working angle of the operator's preferred eye-level is possible with the machine. The computer, designed along modern lines, is compact, light in weight and made of strong, durable materials that will last indefinitely. Special computers, embodying these features, can be designed for any rate, data, and calculation procedures. **Ayres Corporation, Box 1081, Wilmington, Calif.**

Engineering Service

A SERVICE WHICH FURNISHES solutions to complex problems in dynamics for industrial organizations, government bureaus and researchers, has been inaugurated. The service should prove useful for qualitative and quantitative studies in aerodynamics, servo-analysis, mechanical engineering, chemical processing, thermodynamics and many other fields. Such studies can determine optimum specifications for a single component or a total dynamic system. **Computer Corporation of America, 149 Church St., New York, 7, N.Y.**

Equipment, Materials & Methods (Continued)

Scraper

A 22-YD TRACTOR-DRAWN scraper, the TC-190, has been announced. Designed for use with today's largest tractors, the model offers capacities of 19.0 cu yds struck and 22.0 heaped. Standard type side cutters of manganese alloy steel are bolted on to protect bowl side sheets.

TC-190

For rocky terrain and extremely tough material, optional oversized side cutters of extra thickness and strength are available. The TC-190 was engineered to meet specific requests by contractors for a larger scraper with basic characteristics of current models TC-142 and TC-170. Rapid loading results from latest application of the "boiling bowl" principle. Positive fast dumping with less tractive effort is achieved by a rolling motion applied by the Wooldridge ejector, pivoted at the blade base. Among other features are simple cable reeving and long cable life, maneuverability aided by low gravity center with high ground and yoke clearance, and extreme ruggedness. Request Bulletin No. TC-250. **Wooldridge Mfg. Co., Sunnyvale, Calif.**

Rubber Tile

THE POTENTIAL USE of rubber tile for flooring has been increased substantially by a development which now makes it possible to install rubber tile on grade concrete. Heretofore, rubber tile could not be recommended for on-grade or below-grade installations where the tile was laid on concrete slabs in contact with the ground for fear that moisture would affect the adhesive and loosen the tiles. That problem has now been successfully overcome by a chemically-set adhesive, called "Chem-Set," which will not deteriorate when exposed to moisture and which can now be used to cement tiles to on-grade concrete. The product does not waterproof a concrete surface, but it does provide an adhesive bond that will not let go in the presence of moisture. "Chem-Set" offers no problems to the installer as it is applied almost exactly in the same manner as ordinary adhesives. **Pioneer Latex & Chemical Co., Lincoln Blvd., Middlesex, N.J.**

When Requesting Product Information Please Mention Civil Engineering

EXPERT "GUNITE" REPAIRS SAVE DAM

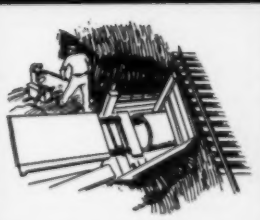
In 1944, we were called upon to make "GUNITE" repairs on the Connecticut Light and Power Corporation's Tunnel Dam. Its poor condition, at that time, is shown in the upper right picture.

After chipping away all loose and unsound masonry, we installed a system of drainage channels and weep pipes and completely reintegrated the downstream face with reinforced "GUNITE." The photo at left shows the actual application of "GUNITE" over welded reinforcing mesh.

Other dams we have saved by this method are pictured in Bulletin (B) 2400, together with a wide variety of other "GUNITE" applications. Write today, on your letterhead, for a copy.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN

DIFFICULT FOUNDATION WORK



- FOUNDATIONS
- CAISSONS
- UNDERPINNING
- SHEETING & BRACING
- PILING & SHEETING
- SHORING
- COFFERDAMS
- MOVING STRUCTURES
- SPECIAL SERVICES

Write for revised catalog.

SPECIAL SERVICES

The scope and variety of our special engineering services to meet extraordinary problems created by the magnitude of a project or any types of complications, have over the years established outstanding engineering achievement records for Spencer, White & Prentis, Inc.

Although we are staffed and equipped to do work of any size, the more difficult projects benefit most from the great variety of services rendered.

The Spencer, White & Prentis organization is available for consultation without obligation.

SPENCER, WHITE & PRENTIS, INC.

10 East 40th Street, New York 16 • Hammond Bldg., Detroit, Mich.

In Canada

Spencer, White & Prentis of Canada, Ltd.

700 Bay St. Toronto, Ontario
209 Park Bldg. Windsor, Ontario
2052 St. Catherine's St., W. Montreal, Quebec

RELY ON...

WILD
HEERBRUGG

STAINLESS STEEL DRAWING INSTRUMENTS DESIGNED for HIGHEST ACCURACY

RZ-20 $19.00
F.O.B., Brooklyn, N. Y.

WILD drawing instrument sets of outstanding merit, Swiss precision engineered, excel in precision and accuracy for the most exacting standards.

CHECK THESE OUTSTANDING FEATURES

★ Rustproof steel, 5 times stronger than brass
★ Improved straight guidance of the compass-head
★ Fine finish of drawing pens
★ A modern metal case, not an old-fashioned box

Complete Sets or Single Instruments Available

•

CHECK OUR LOW PRICES

•

See your regular dealer or write for Bklt. CE 8

HENRY WILD
SURVEYING INSTRUMENTS SUPPLY CO.
OF AMERICA, INC.
26 COURT ST., BROOKLYN 2, N. Y. TRiangle 5-0644

Equipment, Materials & Methods (Continued)

Cable Reel Jack

A LIGHTWEIGHT REEL JACK known as the Simplex A1029, features an aluminum housing that reduces weight 21 lbs. A single-acting jack, it provides easier lifting action than its double-acting predecessor. It has a rugged, laminated oak "T" base and other noted features of Simplex ratchet lowering jacks. The A1029 is particularly recommended for field work, where its reduced weight is a distinct advantage. Its light weight minimizes fatigue in loading, unloading and carrying to location as well as reducing the load on utility trucks. Capacity is 10 tons. Closed height is 29 in., lift 13¾ in., weight 83 lbs, and a 5 ft lever bar is supplied. **Templeton, Kenly and Company, 1020 Central Ave., Chicago 44, Ill.**

Portable Diesel Engine Pyrometer

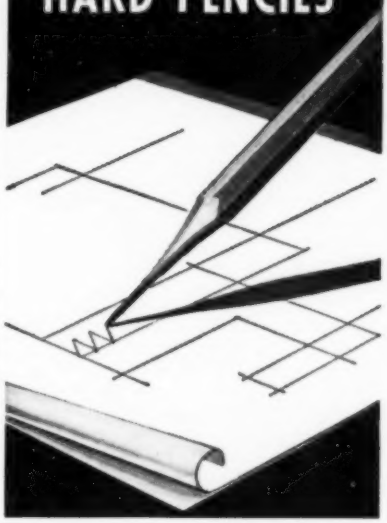
A PORTABLE DIESEL ENGINE pyrometer has just been announced. The instrument is designed for test purposes and for installations where no permanently mounted pyrometer is available. The thermocouples can be installed in each cylinder and in the main exhaust line. Temperatures can then be checked at any time by inserting the pyrometer prongs into the corresponding receptacles in the terminal head of the thermocouple. The pyrometer, Model 4-321, is described in Bulletin P1247, which is available on request. **The Bristol Company, Sales Promotion Dept., Waterbury 20, Conn.**

Dump Truck Hoists and Bodies

A COMPLETE LINE of hydraulic dump truck body hoists and bodies featuring many outstanding design improvements has just been announced. Fourteen models of the hoist are available in a selection of capacities from 6 to 25 tons. The body hoists feature the industry's lowest standard mounting height; advance lifting point; new low operating oil pressures; a "uniflex" subframe; friction-free roller bearing drive mechanism, including pump and power takeoff, to insure quiet operation and long trouble-free life. A unique stress-eliminating design feature of the hoists almost entirely absorbs dumping shocks and permits use of a new principle in hoist design—a flexible sub-frame which ends tendency of rigid hoists to crack or bend when flexed. The efficiency of the hoists permits the use of extremely low operating oil pressures for any given capacity, assurance of long hoist service and low upkeep. New contractor's type bodies were released with the hoists as matching units. Bodies are available in a wide range of capacities to fit all applications. Reinforced tailgate has offset hinges for adaptability to wide spreading conditions. **Customer Service Dept., St. Paul Hydraulic Hoist, Wayne, Mich.**

Imperial

TRACING CLOTH FOR HARD PENCILS



• Imperial Pencil Tracing Cloth has the same superbly uniform cloth foundation and transparency as the world famous Imperial Tracing Cloth. But it is distinguished by its special dull drawing surface, on which hard pencils can be used, giving clean, sharp, opaque, non-smudging lines.

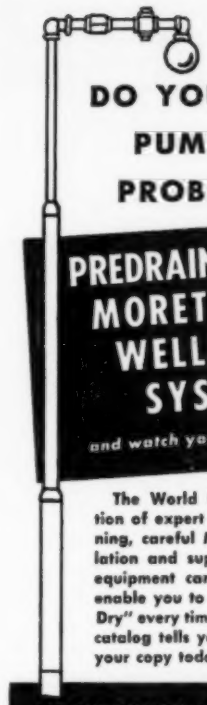
Erasures are made easily, without damage. It gives sharp, contrasting prints of the finest lines. It resists the effects of time and wear, and does not become brittle or opaque.

Imperial Pencil Tracing Cloth is right for ink drawings as well.

Imperial

PENCIL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE.



DO YOU HAVE PUMPING PROBLEMS?

PREDRAIN WITH A MORETRENCH WELLPOINT SYSTEM

and watch your profits grow

The World famous combination of expert Moretrench planning, careful Moretrench installation and superior Moretrench equipment can't be beat. They enable you to excavate "In the Dry" every time. The Moretrench catalog tells you how. Send for your copy today.

MORETRENCH CORPORATION
90 WEST STREET
NEW YORK 6, NEW YORK
Chicago, Ill. - Tampa, Fla. - Houston, Tex.

Read

APPLIED MECHANICS REVIEWS

For its expert appraisal of world literature in applied mechanics and related engineering sciences.

To critically survey the important literature contained in 525 engineering and scientific journals, in new books, and in reports of research agencies of 28 countries.

For keeping abreast of significant advances throughout the whole field with a minimum of time.

See for yourself how easy it is to follow major developments with the aid of APPLIED MECHANICS REVIEWS by reading the next seven issues. Arrange to send for them today at a special introductory price of $4.50.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39th St., New York 18

Equipment, Materials & Methods (Continued)

Truck Crane

THE MITI-MITE TRUCK CRANE makes its bow after more than five years of development and thorough field testing. It is designed exclusively for truck service and is not an adaptation of a crawler excavator. The Miti-Mite is designed to mount on any truck of suitable capacity.

Miti Mite

Special engineering makes installation simple and fast. It is readily convertible for any front end service—shovel, trench hoe, dragline, clamshell, crane and magnet crane, etc., and performs equally well at each of these jobs. It has a $^3/_8$ cu yd capacity as shovel and 7-ton capacity as crane. The Miti-Mite introduces many distinctive innovations to the small truck crane field. Notable among these is its power box design. This concept of crane design provides a single, compact box to contain all driving machinery. The full revolving upper is welded integrally as a heavy power box which forms the machine frame and supports all shafts, drums, gantry, engine, counterweight and front end attachments. A 6-cylinder gasoline engine provides power, driving through a heavy duty 4-speed transmission. Second speed is normal digging speed. All machinery is fully enclosed, running in oil. P&H has applied its improved hydraulic control to the Model 55. These are of the low pressure automotive type and give smooth, positive response. All controls are conveniently grouped for the operator's comfort and safety of performance. **Harnischfeger Corporation, 4400 W. National Ave., Milwaukee 46, Wis.**

Fireproofing Systems

THOUSANDS of dollars and, in some constructions, tons of steel can be saved in the structural frame for commercial, apartment and institutional buildings through the use of gypsum lightweight fireproofing systems recently announced to the building industry. Briefly, the fireproofing constructions consist of one or two layers of gypsum lath, which is wrapped around the perimeter of the steel column and tie-wired. Plaster then is applied to the thickness required by the fire-rating sought. Gypsum lath is attached to floor beams with the aid of $^3/_4$ in. channels, to which it is secured with wire clips. The two layers of gypsum lath are used for the higher fire ratings. **The Gypsum Association, 20 North Wacker Drive, Chicago, Ill.**

This SMITHway walkway—covered with slippery drilling mud—is safe to walk on.

A.O.Smith
100% SERRATED
Safety Grating Pays Its Way

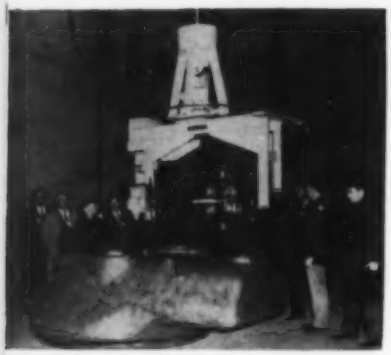
- **In money saved** . . . by reducing accidents
- **In man-hours saved** . . . by fewer accidents
- **In maintenance saved** . . . locked-for-life construction cuts maintenance costs
- **In value** . . . 100% serrated surface at no extra cost, no premium price!

MAKE SURE of SAFETY

A. O. Smith 100% Serrated Safety Grating, completely engineered and fabricated to your individual requirements, is available from local stocks listed below.

A.O.Smith
CORPORATION
Milwaukee 1, Wisconsin
International Division
P. O. Box 2023, Milwaukee 1, Wisconsin

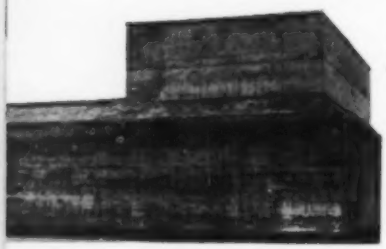
Local Stocks Available at:
Atlanta: Golian Steel & Iron Co.
Chicago: Central Steel & Wire Co.
Dallas: Vinson Supply Co.
Denver: Eaton Metal Products Co.
Detroit: Central Steel & Wire Co.
Houston: Ferrous Products Co.
Kansas City: A. M. Castle & Co.
Los Angeles: Bufnel Co., Ltd.
Milwaukee: A. O. Smith Corp.
Minneapolis: Kellor Steel, Inc.
New Orleans: Equitable Equipment Co.
New York: A. O. Smith Corp.
Portland, Ore.: Pacific Steel Warehouse
San Francisco: A. M. Castle & Co.
Seattle: A. M. Castle & Co.
Shreveport: Superior Iron Works & Supply Co.
Toledo: Baron Steel Co.
Tulsa: Braden Steel Co.



This Betatron is an extra powerful x-ray camera capable of generating 24,000,000 electron volts.

GIANT X-RAY MACHINE

supported by Koppers Pressure-Creosoted Piles



This 4,000-ton concrete Betatron Building is supported by Koppers Pressure-Creosoted Foundation Piles.

ONE of the two largest industrial Betatrons in the world is installed at the Eddystone Plant of General Steel Castings Company. It was built by the U. S. Army Corps of Engineers, Philadelphia District. This powerful 24,000,000-volt x-ray machine is used to inspect heavy steel castings for U. S. Army tanks.

Personnel is protected from dangerous radiation by solid concrete walls 6-feet thick. To support the 4,000-ton Betatron Building and provide the absolute stability required, Koppers Pressure-Creosoted Foundation Piles were used.

Koppers Pressure-Creosoted Piles provide *lasting* protection—and they *cost less* than other permanent pile materials. For more information on Koppers Pressure-Creosoted Piles, write to Koppers Company, Inc., Pittsburgh 19, Pa.

KOPPERS COMPANY, INC., Pittsburgh 19, Pa.

KOPPERS PRESSURE-TREATED WOOD

Equipment, Materials & Methods (Continued)

Horizontal Cellar Drainer

PRODUCTION OF a close-coupled-type horizontal cellar drainer has been announced. The unit, called Figure 3631, provides positive protection from flooded cellars without the limitations and disadvantages of the conventional vertical submerged-type drainers. The pump unit

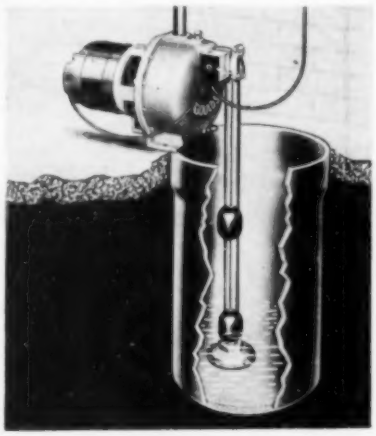


Figure 3631

is never subject to binding or clogging due to accumulated silt, sand, coal, dust, ashes, etc. in sump, because the pump itself is not in the pit. Thus it can't be exposed to the annoyance of silt accumulation encountered in the vertical type which leads to burned-out motors, inoperative pumps and flooded cellars. Other important selling features are that the sump and strainer are easily cleaned, the motor is not subject to vapor, moisture, or fumes from the sump (since the motor is not over the sump) and the unit may be set away from the sump (up to 8 ft offset possible—often desirable in tight locations). The close-coupled construction of this unit assures permanent alignment of rotating parts, the centrifugal pump is self-priming, and the impeller and guide vane are of non-rusting bronze. **Goulds Pumps Inc., Seneca Falls, N.Y.**

Adjustable Shores

SPEEDING CONSTRUCTION PROJECTS all over the country, the time-tested Rooshor is meeting the requirements of contractor for speed and efficiency in shoring operations. Rooshors are the fully adjustable one man shore with the incorporating upper members of wood, so that they can be easily braced in any direction. Although bracing is ordinarily not necessary, it can be easily accomplished with Rooshors with greater speed. They are adjustable every fraction of an inch, yet screw adjustments which may become clogged with concrete or pins which may become lost, are not used. **Baker-Roos, Inc., 602 West McCarty St., Indianapolis, Ind.**

with "GUNITE"

PRESSURE CONCRETE CO.

gives cement greater utility, versatility!

FOR REPAIRING: Reservoirs, Dams, Filter Plants, Sewage Disposal Plants, Tanks, Stadiums, Bridges, Sea Walls, Breakwaters.

FOR LINING: Reservoirs, Swimming Pools, Tunnels, Sewers, Pipe, Concrete, Brick and Steel Tanks, Stacks, Bunkers, Irrigation Ditches.

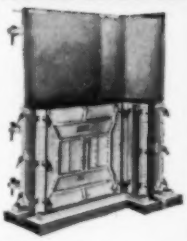
FOR CONSTRUCTING: New Tanks, Stacks, Piles, Sidewalls and Roofs, Steel Encasements.

Write for 48-page illustrated booklet showing "GUNITE" at work.

PRESSURE CONCRETE CO.

NEWARK 5, N. J. 193 Emmet Street
CHICAGO, ILL. 33 No. La Salle Street
CHARLOTTE, N. C. Liberty Life Bldg.
FLORENCE, ALA. So. Court Street

Save manpower time and material



When placing concrete, use this nationwide Form Rental and Engineering Service to increase profits, reduce costs.

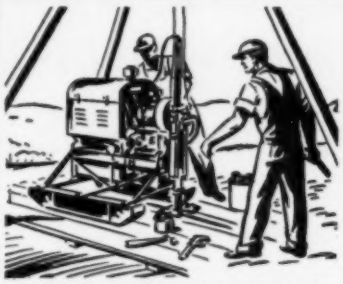
Standard units of Economy Forms fit most jobs. But where needed, special forms can be built to specification.

- Foundations and Walls
- Water or Sewage Treatment Plants
- Tanks — Circular and Rectangular
- Bridges, Culverts and Box Tunnels

ECONOMY FORMS CORP.
Home Office: Des Moines, Ia.

District Sales Offices:
Kansas City, Mo.
Omaha, Neb.
Minneapolis, Minn.
Fort Wayne, Ind.
Cincinnati, Ohio
Pittsburgh, Pa.
Springfield, Mass.
Metuchen, N. J.
Decatur, Ga.
Dallas, Texas
Los Angeles, Calif.
Oakland, Calif.
Denver, Colo.

ECONOMY FORMS
metal forms for concrete construction



CONTRACTORS
for
DIAMOND CORE DRILLING
DRY SAMPLE SOIL BORINGS
FOUNDATION TESTING
PRESSURE GROUTING, ETC.
anywhere in the world

Sixty years of successful experience, backed by superior equipment and ample financial resources, constitute your best possible assurance of satisfactory service. Estimates submitted promptly on request. Manufacturers, also, of Diamond Core Drilling Machines and complete accessory equipment.

SPRAGUE & HENWCOD, Inc.
Dept. C. E., SCRANTON 2, PA.
New York - Philadelphia - Pittsburgh

THE PILE FOR THE JOB

Standard Cased

For fluid ground conditions requiring a cast-in-place pile with a permanent casing. Firm-bonded with surrounding earth, plus end bearing these piles support all types of structures in hundreds of locations throughout the country.
14,400 MacArthur cased piles support the Cincinnati Union Terminal and its surrounding rail facilities and structures.

Send today for your copy of "Planned Piling for Foundation Construction" which tells of this and other MacArthur piles tailored for your foundation work.

MacArthur
CONCRETE PILE CORP.
18 East 48th St., New York 17, N. Y.
New Orleans • Cincinnati • Boston

Literature Available

JOB APPLICATION FOLDER—A profusely illustrated 4-page folder featuring on-the-job applications of the truck-mounted Bantam is being released. It presents actual job applications and production records of Bantam owners, with illustrations of their machines in operation. The variety of job records contained in this folder illustrates the versatility of the Bantam which can be used as back hoe, pile driver, clamshell, dragline, shovel, crane, magnet crane and with various grapples. **Schield Bantam Company, Waverly, Iowa.**

HEATERS—A revised edition of a 12-page bulletin describing "Counterflo" heaters, is now available. Principal addition to the bulletin, No. 523-B, is information concerning use of the heaters for eight other applications besides space heating. These are functional heating, process drying, temporary heating, medium temperature drying, tempering make-up air, drying vehicles after washing, crop drying, and integration with air conditioning systems. **Dravo Corp., Heating Dept., Fifth & Liberty Aves., Pittsburgh 22, Pa.**

COMPRESSORS—A 4-page bulletin descriptive of all types of 105 cfm Davey compressors, is announced. Davey gasoline, diesel and electric-powered trailers; "Auto-Air" truck-mounted units and industrial stationary machines are listed and illustrated in detail. Complete mechanical specifications are included in a handy reference table. Ask for Form E-237. **Davey Compressor Co., Kent, Ohio.**

STEEL CASTINGS—Standard specifications for more than 70 designated classes of steel castings are incorporated in a comprehensive summary chart. The recently prepared chart covers pertinent data on virtually all general engineering types of steel castings, together with recently adopted specifications and some revisions of previous specification standards. Write to **F. Kermit Donaldson, Executive Vice Pres., Steel Founders' Society of America, 92 Midland Bldg., Cleveland 15, Ohio.**

COMPACTION BROCHURE—A 12-page brochure on the history of pneumatic-tired compaction equipment has just been released. The first section contains a condensed background of rubber-tired compaction developments in the construction of super highways, heavy duty airfield runways and giant earth dams. The second section has results of compaction tests conducted at the Oahe Dam project near Pierre, S. Dak. Also shown are charts describing performance of Bros 35 and 50-ton Roll-O-Pactors in various types of fills. Details and specifications on the Roll-O-Pactor are in the third section. **Road Machinery Div., Wm. Bros Boiler & Mfg. Co., Minneapolis 14, Minn.**

SPECIFY
STEVENS
RECORDER
TYPE B

Meet the threat of stream pollution with accurate data graphically tabulated with a STEVENS Flow Recorder. Complete flow records simplify task of treating wastes in compliance with anti-pollution laws.

The STEVENS Type B Recorder keeps permanent records of flow and totalizes volume of liquids passing through weirs, Parshall flumes, or other measuring structures. Models also available to record head only, if desired.

- **Standard circular chart automatically records 1- or 7-day periods.**
- **Remote operation available where required.**

Write for FREE Bulletin 25 which gives a detailed description of the STEVENS Recorder, Type B.

NEW STEVENS DATA BOOK AVAILABLE

Puts interpretive data at your fingertips. 156 pages of technical data on float-operated instruments...a wealth of hydraulic tables and conversion tables...information on STEVENS liquid measuring instruments to meet every need **$1.00**

Foremost in Precision Hydraulic Instruments Since 1907

LEUPOLD & STEVENS INSTRUMENTS, INC.
4445 N. W. GLISAN, PORTLAND 13, ORE.

TIDE GATES

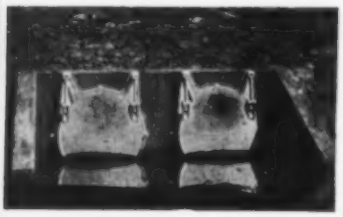


Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

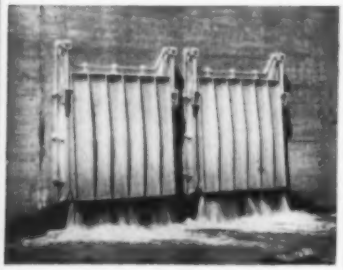


Fig. B-124-C
Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

BROWN & BROWN, INC.
LIMA, OHIO, U.S.A.

Core size from 7/8" to 36" for Dams, Bridges Buildings, etc.

Foundation
TEST BORINGS
★
An Engineering Service
For Engineers
By Engineers
Literature upon request.

PENNSYLVANIA Drilling CO.
DRILLING CONTRACTORS
PITTSBURGH 20, PA.

Literature Available (Continued)

SELF-PRIMING CENTRIFUGAL PUMPS—Bulletin No. 110 on Carver engine driven, self-priming centrifugal pumps is available. One of the outstanding features of the pumps is the long life mechanical seal with wearing surfaces almost diamond hard. It assures fast priming and non-leaking pumps after years of tough service. Performance tables, photographs, sectional views, and other valuable information is included. **Carver Pump Co., Muscatine, Iowa.**

HEAVY EQUIPMENT—For the first time in the heavy machinery field, a comprehensive guide illustrating the use of tractor-mounted tools in all basic industries such as railroading, construction, light and heavy logging, farming, mining, oil and gas and governmental projects, has been released. Printed in four colors, the brochure uses an unique cartoon-style which effectively presents many of the principle uses for this type of equipment. **Hyster Company, 2903-05 N. E. Clackamas St., Portland 8, Ore.**

WATER LINES—The fifth annual report of water lines entitled, "A Report of Dresser-Coupled Steel Water Lines in the Year 1951" has been released. The attractive, 12-page illustrated report carries construction details on principal steel water lines laid during the past year. Waterworks engineers and contractors interested in latest developments in water line construction methods and materials will find this report of value. **Dresser Mfg. Div., Dresser Industries, Inc., Bradford, Pa.**

GRAVITY FILTERS—A comprehensive and well documented 24-page booklet, No. 2539A, of interest to all engineers dealing with water problems has been prepared. It shows the complete line of gravity filters and filter accessories manufactured. Specifications, operating characteristics, outline dimensions and typical installation photographs have been included in this edition. **The Permutit Company, 330 West 42nd St., New York 36, N.Y.**

ROLLER CHAIN BOOK—A 148-page roller chain engineering data book, No. 2457, has just been published and is now available for distribution. It is one of the most comprehensive books ever developed on roller chain and its application. Detailed engineering information covers the selection, installation, lubrication, and maintenance of roller chain for drives and conveyors, and sprocket wheels. For reference and easy identification, the book contains a large number of photographs and line drawings of the many types and sizes of chain and sprocket wheels available in the Link-Belt precision steel roller chain line. In addition, over 50 typical conveyor chain attachments are shown. **Link-Belt Company, 307 N. Michigan Ave., Chicago 1, Ill.**

BUCKET LADDER
DREDGES
for
SAND—GRAVEL

- MONAZITE—RARE EARTHS
- SCREEN PLATES
- BUCKET PINS
- SAND PUMPS
- YUBA JIGS

YUBA DREDGES — PROVED DEPENDABILITY

YUBA MANUFACTURING CO.
Room 716 - 351 California Street
San Francisco 4, Calif.
CABLES: Yubaman, San Francisco
Shawdarbco, London

LEFAX★★★
POCKET SIZE TECHNICAL DATA BOOKS $1 EACH

Printed on loose leaf, six hole, 6¾" x 3¾" bond paper, each book contains about 140 pages of technical data, presenting condensed, accurate and essential data for the student, engineer, technical worker and business man.

• • •

Architecture	Transformers, Relays, Meters
Home Heating	Hydraulics
Illumination	Surveying
Electrician's Data	Mech. Drawing
Builder's Data	Machine Design
Lumber Data	Machinists' Data
Air Conditioning	Piping Data
General Math.	Surveying Tables
Math. Tables	Trig-Log Tables
Physics	Metallurgy
Chemical Tables	Analytic Chemistry
Metals	Highway Engineering
Gen'l. Chemistry	Mechanics of Materials
Reinforced Concrete	Power Trans. Mach'y.
Building Construction	Thermodynamic Tables & Charts
Radio	Phys. & Thermodynamic Data
Television & FM	Phys. & Org. Chemistry
Electricity, AC	
Electricity, DC	
AC Motors and Generators	

Write for FREE Catalogs (over 2000 listings). See for yourself how helpful LEFAX can be to you. Send $1 for each book, or $5 for any six books listed above, to:

LEFAX, Dept. CIV-11 Philadelphia 7, Pa.

PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 120.

Summarized in Earlier Issues

128. **Horizontally Curved Box Beams,** by Charles E. Cutts.

129. **Analysis of Arch Dams of Variable Thickness,** by W. A. Perkins.

130. **Underground Corrosion of Piping,** by R. A. Brannon.

131. **The Allegheny Conference—Planning in Action,** by Park H. Martin.

132. **Specifications for Structures of a Moderate Strength Aluminum Alloy of High Resistance to Corrosion, Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys.**

D-66. Discussion of Paper, **Lateral Forces of Earthquakes and Wind,** by a Joint Committee of the San Francisco Section of ASCE, and the Structural Engineers Association of Northern California.

D-79. Discussion of Paper, **Stage Predictions for Flood Control Operations,** by Ralph E. King.

D-80. Discussion of Paper, **Mississippi River Valley Geology Relation to River Regime,** by Harold N. Fisk.

Third Notice

133. **Uplift in Masonry Dams: Final Report of the Committee on Masonry Dams of the Power Division, 1951.**

134. **Solution of an Hydraulic Problem by Analog Computer,** by R. E. Glover, D. J. Herbert, and C. R. Daum.

135. **Application of Electronic Flow Routing Analog,** by Max A. Kohler.

136. **Steady-State Forced Vibration of Continuous Frames,** by C. T. G. Looney.

D-75. Discussion of Paper, **Base Course Drainage for Airport Pavements,** by A. Casagrande and W. L. Shannon.

D-76. Discussion of Paper, **Model Tests Using Low-Velocity Air,** by James W. Ball.

Second Notice

137. **Construction of the Delaware Memorial Bridge,** by Homer R. Seely. This structure, crossing the Delaware River about two miles south of Wilmington, Del., and forming the southern gateway to the New Jersey Turnpike, takes its place as the world's sixth bridge in order of length of suspended span. The paper outlines the legislative steps leading up to the construction and briefly describes the building of the foundations. The procedures followed in spinning the cables and the erection of the superstructure are explained in more specific detail. (Available August 1.)

138. **The Value and Administration of a Zoning Plan,** by Huber Earl Smutz. The first half of the twentieth century has witnessed more beneficial progress than any other given period in the history of civilization. Undoubtedly the outstanding civic development during this half century has been the remarkable development and spread of city planning and zoning, particularly comprehensive zoning, in American cities. (Available August 1.)

139. **Nonlinear Electrical Analogy for Pipe Networks,** by Malcolm S. McIlroy. The labor involved in solving the simultaneous head-loss equations for a pipeline network is eliminated by an electric network analyzer composed of special nonlinear resistors. Analogies between hydraulic and electric quantities are explained, and values of useful constants are tabulated. Accuracy of the procedure is shown to be satisfactory. Results of analyzing a network by means of the nonlinear electric circuit are compared with results of rigorous algebraic solutions. (Available August 1.)

140. **Irrigation Water Rights in the Humid Areas,** by Howard T. Critchlow. In the eastern part of the United States, and especially in New Jersey, the practice of supplemental irrigation has been growing, resulting in increased competition for the use of water for all purposes in large centers of population and industrial development. To deal with this subject, the paper is divided into two parts—general description of present practice, and water rights. (Available August 1.)

141. **Effect of Entrance Conditions on Diffuser Flow,** by J. M. Robertson and Donald Ross. Flow studies of conical diffusers of 5-, 7½-, and 10-deg total angles preceded by 20-, 5-, and 9-dia lengths of pipe are reported. Diffuser-area ratio was found to be the major geometric parameter governing the shape and extent of the boundary layer, and the initial boundary layer thickness was found to be as important as the diffuser angle. It is concluded that the only consideration affecting choice of diffuser geometry is the prevention of separation. Results are applied to the design of a large high-speed water tunnel. (Available August 1.)

D-86. Discussion of Paper, **Ground-Water Phenomena Connected with Spreading,** by Paul Baumann. The original paper, published in August 1951, described conservation by the diversion of clear stream flow to off-channel areas as practiced in Los Angeles County, California. Discussers are: David

INSTRUCTIONS

1. Papers are to be ordered by serial number. Please keep record of Separates you have ordered to avoid unwanted duplication.

2. Any ASCE member may order a total of 40 copies of papers during the fiscal year ending September 30, 1952, without charge. These may be duplicates of the same paper, separate papers, or a combination of both.

3. Members' accounts will be charged at 25¢ each for orders exceeding 40 copies in a fiscal year. Charges for excess copies or for subscriptions will be included on the 1953 dues bills.

4. Non-members of the Society may order copies of PROCEEDINGS papers by letter with remittance of 50¢ per copy; members of Student Chapters 25¢ per copy.

5. Discussions of each paper, with author's closure, also will be published as a Separate and must be ordered in the same manner as other Separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

Standing orders for all Separate papers, including their Discussions, in any calendar year, may be entered at the following annual rates: Members of ASCE, $5.00; members of Student Chapters, $3.00; non-members, $10.00, plus foreign postage charge of $.75; libraries, $5.00.

TRANSACTIONS All PROCEEDINGS papers, with discussions, will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

	To Members	To Non-Members
Leather binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper binding	2.00	16.00

K. Todd, Max Suter, D. P. Krynine, and Paul Baumann. (Available August 1.)

D-87. Discussion of Paper, **Sewage Reclamation by Spreading Basin Infiltration,** by Ralph Stone and William F. Garber. The original paper, published in September 1951, discussed a field study at two test installations located at Whittier and Azusa, Calif. Discussers are: R. B. Krone, J. F. Thomas and Harvey F. Ludwig; A M Rawn and F. R. Bowerman; and Ralph Stone and William F. Garber. (Available August 1.)

D-92. Discussion of Paper, **Experimental Investigation of Fire Monitors and Nozzles,** by Hunter Rouse, J. W. Howe, and D. E. Metzler. The original paper, published in October 1951, described the design of a fixed monitor, a portable monitor, and a nozzle that will reduce flow turbulence to a practicable minimum. Discussers are: G. Halbronn; Pierre Oguey, and Marcel Mamin and François Baatard; John H. Arnold; and Hunter Rouse, J. W. Howe and D. E. Metzler. (Available August 1.)

D-96. Discussion of Paper, **Surface Curves for Steady Nonuniform Flow,** by Robert B. Jansen. The original paper, published in October 1951, presented a rapid method of determining the water surface curve for steady, varied flow in a prismatic open channel. Discussers are: Ivan M. Nelidov, J C. Stevens, Maurice Bishap and H. E. Babbitt, K. C. Wu, J. Pietrkowski, and Robert B. Jansen. (Available August 1.)

D-100. Discussion of Paper, **Forced Vibrations of Continuous Beams,** by Edward Saibel and Elio D'Appolonia. The original paper, published in November 1951, presented the determination of the forced oscillations of a continuous beam caused by an exciting force. Discussers are: W. H. Hoppmann, and Edward Saibel and Elio D'Appolonia. (Available August 1.)

First Notice

142. **Unconfined Ground-Water Flow to Multiple Wells,** by Vaughn E. Hansen. The purpose of this paper is to clarify the nature of unconfined flow to single and multiple wells, and to present a method of solving problems associated with this type of flow. The effect of the capillary fringe on the location of the free surface and the form of the flow patterns, the zone of validity of the Dupuit equation, the shape of the free surface near the well, and the variation in the stream-surface spacing are all discussed. A functional relationship independent of the radius of influence is established, relating the variables at the well; this relationship applies to both single and multiple wells. A fundamental dimensionless parameter consisting of a ratio of Froude's to Reynolds' number is formulated that characterizes the shape of the cone of depression around a well. The concepts of well efficiency and effectiveness are clarified and guides are presented for their correct use. (Available September 1.)

143. **Electrical Analogy in Problems of Three Dimensions,** by P. G. Hubbard and S. C. Ling. Engineers whose work includes the design of low-loss transitions of air-conditioning systems, water-supply systems, or hydraulic outlet works will be particularly interested in the experimental methods and typical results presented in this paper. The principles involved are analogous to those of the flow net or relaxation methods already used for two-dimensional work, but the requirements or symmetry about one axis are removed. An inexpensive, versatile tool of high accuracy is the result. (Available September 1.)

144A.

144B. **Aerodynamic Stability of Suspension Bridges, Progress Report of the Advisory Board on the Investigation of Suspension Bridges.** The aerodynamic forces which act on a bridge in the wind, and the occurrence of resonance of the motion, depend on the velocity and direction of the wind and the size, shape, and motion of the bridge. The amplitude of oscillation depends on the strength, variation, and duration of wind forces and the energy storage capacity and damping of the structure. The remaining unknown factor is supplied by a test that relates the motions of a dynamic section model to a properly scaled wind. Means are discussed of designing a bridge which will be safe against objectionable oscillation in the wind. Because of its length (63 pages), this paper is rated as two Proceedings-Separates, and priced accordingly. (Available September 1.)

145. **Torsion of I-Type and H-Type Beams,** by John E. Goldberg. Beginning with a review of pure torsion and torsion bending of I-type and H-type sections, the basic differential equation is obtained for the twisting of such sections. The stresses resulting from twist—namely, the simple torsional stresses and longitudinal and shearing stresses due to warping restraints—are discussed from the engineering standpoint. Particular solutions of the differential equation are obtained for various warping conditions at the ends, and it is shown how these solutions are combined to formulate and analyze various problems, including that of a framed floor panel. (Available September 1.)

146. **Electrical Analogies and Electrical Computers: Surge and Water Hammer Problems,** by Henry M. Paynter. This paper describes the basis for the application of electrical-hydraulic analogies and electronic analog computers to problems in hydraulic transients. Water hammer studies in a uniform pipe and surges in a simple tank are discussed in some detail. In addition to promoting understanding of the underlying phenomena of unsteady flow, analog techniques are demonstrated as furnishing formulas capable of practical applications. (Available September 1.)

147. **The Delaware Memorial Bridge: Design Problems,** by Charles H. Clarahan, Jr., and Elmer K. Timby. One of the major suspension spans thus far constructed, this bridge emphasized the need for knowledge of the behavior of such structures in order that maximum economy in design may be attained. The provisions for torsional resistance in this bridge include a double lateral system. Design specifications are discussed in some detail. The solutions to problems inherent in the particular foundation conditions encountered are explained. Correlation of the design with model tests has proved helpful and these tests are being continued. (Available September 1.)

D-84. Discussion of paper, **Longitudinal Mixing Measured by Radioactive Tracers,** by Harold A. Thomas, Jr., and Ralph S. Archibald. The original paper, published in August 1951, presented a method of determining the magnitude and effect of horizontal mixing in pipes and tanks as available to the engineer through the use of radioactive tracers. Discussers are: Conrad P. Straub and Donald A. Pecsok, Alfred C. Ingersoll, Harold A. Thomas, Jr., and Ralph S. Archibald. (Available immediately.)

For the Use of ASCE Members Only

PROCEEDINGS PAPERS ORDER FORM

AMERICAN SOCIETY OF CIVIL ENGINEERS

33 W. 39 ST.. NEW YORK 18, N.Y.

Enter my order for Separate PROCEEDINGS Papers which I have circled below:

Paper No. 128 129 130 131 132 D-66 D-79 D-80 133 134 135 136 D-75 D-76 137 138 139 140 141 D-86 D-87 D-92 D-96 D-100 142 143 144A 144B 145 146 147 D-84

If more than one copy of a paper is desired, indicate here

Name (Please Print) Membership Grade

Address

Signature Date

Professional Services

Listed alphabetically by states

EWIN ENGINEERING CORPORATION
Design and Construction
Investigations, Reports, Appraisals, Estimates and Management Surveys, Port Facilities, Foundations, Industrial Plants, Bridges and Structures.
P. O. Box 361 **Mobile 3, Ala.**

PALMER & BAKER, INC.
Consulting Engineers and Architects
Problems of Transportation, Subaqueous Vehicular Tunnels, Rock Tunnels, Utility Tunnels, Bridges, Grade Separations, Highways, Airports, Traffic Studies, Parking Problems, Waterfront & Harbor Structures
Complete Material, Chemical and Soils Laboratories
New Orleans, La.
Mobile, Alabama **Houston, Texas**

JOHN S. COTTON
Consulting Engineer
Hydroelectric, irrigation, water supply, and multiple purpose projects, flood and erosion control, river basin development planning, dams and their foundations, tunnels, marine structures, valuations, rates.
28 Brookside Drive, San Anselmo, Calif.

DAMES & MOORE
Soil Mechanics Engineering
General Offices
816 West Fifth Street
Los Angeles 17
Regional Offices in
Los Angeles . San Francisco . Portland Seattle . New York

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations—Reports—Design Procurement—Field Engineering Domestic and Foreign
74 New Montgomery St.
San Francisco 5, California

MAURSETH & HOWE
Foundation Engineers
Airports, Highways, Tanks, and Structures
Offices and Laboratories: 8953 Western Ave. Los Angeles 47, Calif.
Eastern Associate: George R. Halton Newark, N. J.

KAISER ENGINEERS
Division of Henry J. Kaiser Company
ENGINEER - CONTRACTOR
Investigations - Reports - Valuations Design - Construction
Twinoaks 3-4600
1924 Broadway **Oakland, Calif.**

CLYDE AND ASSOCIATES
Consulting Civil Engineers
Soil and Foundation Engineering
Asphalt Mix Design and Control
Airport Runways and Pavement Design
3405 Piedmont Avenue
Oakland 11, Calif.

O. J. Porter & Company
CONSULTING ENGINEERS
Airports—Highways—Dams
Foundation — Stabilization — Pavements
3757 Wilshire Blvd., Los Angeles, Calif.
516 9th St., Sacramento, Calif.

KIDDER & THOMA
Cadastral Engineers
Large Scale Cadastral Surveys
Riparian Rights, Boundary Locations
Preparation for Trial of Suits
Consultations
Joseph C. Thoma
4811 Blagden Avenue, N. W.
Washington 11, D. C.

DUVAL ENGINEERING & CONTRACTING CO.
General Contractors
FOUNDATION BORINGS
For Engineers and Architects
Jacksonville **Florida**

RADER ENGINEERING CO.
Water Works, Sewers, Refuse Disposal, Ports, Harbors, Flood Control, Bridges, Tunnels, Highways, Airports, Traffic, Foundations, Buildings, Reports, Investigations, Consultations
1615 duPont Building **Miami, Florida**

ALVORD BURDICK & HOWSON
Charles B. Burdick
Louis R. Howson **Donald H. Maxwell**
Consulting Engineers
Water Works, Sewerage, Water Purification, Sewage Treatment, Flood Relief, Power Generation, Drainage, Appraisals.
20 North Wacker Drive, Chicago 6, Ill.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas and Electric Transmission Lines
351 East Ohio Street, Chicago 11, Ill.

DeLEUW, CATHER & COMPANY
Consulting Engineers
Transportation, Public Transit and Traffic Problems
Industrial Plants, Grade Separations, Railroads, Subways, Power Plants, Expressways, Tunnels, Municipal Works
150 N. Wacker Drive, Chicago 6, Ill. **79 McAllister St. San Francisco 2**

GREELEY AND HANSEN
Engineers
Samuel A. Greeley, Paul E. Langdon, Thomas M. Niles, Kenneth V. Hill, Samuel M. Clarke
Water Supply, Water Purification, Sewerage, Sewage Treatment, Refuse Disposal, Industrial Wastes
220 S. State Street, Chicago 4, Ill.

HARZA ENGINEERING COMPANY
Consulting Engineers
L. F. Harza
E. Montford Fucik **Calvin V. Davis**
Hydro-Electric Power Projects
Transmission Lines, System Management, Dams, Foundations, Harbor Structures, Soil Mechanics
400 W. Madison St., Chicago 6, Ill.

SOIL TESTING SERVICES, INC.
Carl A. Metz
Theo. W. Van Zelst
John P. Gnaedinger
Foundation Borings
Field and Laboratory Tests of Soils
Analyses and Reports
Soil Testing Apparatus
4520 West North Avenue
Chicago 39, Ill.

JENKINS, MERCHANT & NANKIVIL
Consulting Engineers
Municipal Improvements — Sewerage
Power Development — Water Systems
Traffic Surveys — Industrial Plants
Flood Control — Recreational Facilities
Airports — Investigations and Reports
805 East Miller Street
Springfield, Illinois

STANLEY ENGINEERING COMPANY
Consulting Engineers
Airports — Drainage — Electric Power
Flood Control — Industrial Rate Studies
Sewerage — Valuation — Waterworks
Hershey Building, Muscatine, Iowa

HAZELET & ERDAL
Consulting Engineers
Bridges — Foundations
Expressways — Dams — Reports
Monadnock Block
Chicago
403 Commerce Bldg., Louisville
Dixie Terminal Bldg., Cincinnati

EUSTIS ENGINEERING COMPANY
FOUNDATION AND SOIL MECHANICS INVESTIGATIONS
Soil Borings *Laboratory Tests*
Foundation Analyses *Reports*
3635 Airline Highway
New Orleans 20, La.

WHITMAN REQUARDT AND ASSOCIATES
Engineers
Sewerage and Water Systems, Airports, Industrial and Power Plants and Other Structures
Reports — Designs — Specifications — Supervision
1304 St. Paul Street, Baltimore 2, Md.

ROBERTSON & ASSOCIATES
Consulting Engineers
Bridges—Structures,—Foundations
Industrial Buildings & Facilities
Highway Planning
Investigations—Designs—Reports
Baltimore, Md. **Richmond, Va.**

CRANDALL DRY DOCK ENGINEERS, INC.
Railway Dry Docks, Floating Dry Docks, Basin Dry Docks, Shipyards, Port Facilities
Investigation, Reports, Design, Supervision
238 Main St., Cambridge 42, Mass.

IRVING B. CROSBY
Consulting Engineering Geologist
Investigations and Reports
Dams, Reservoirs, Tunnels, Foundations, Groundwater Supplies and Resources
Non-Metallic Minerals
6 Beacon Street
Boston 8, Massachusetts

USE THIS PROGESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by members of the American Society of Civil Engineers

Your card should be among them.

Write Today For Rates.

Additional Professional Cards On Pages 122 and 123

Professional Services

Listed alphabetically by states

DUFFILL ASSOCIATES, INC.
Consulting Engineers
80 Boylston St., Boston 16, Mass.

FAY, SPOFFORD & THORNDIKE
Engineers
Charles M. Spofford — Ralph W. Horne
John Ayer — Frank L. Lincoln
Bion A. Bowman — William L. Hyland
Carroll A. Farwell — Howard J. Williams
Bridges and Industrial Plants
Water Supply and Sewerage Works
Port and Terminal Works, Airports
Boston — New York

JACKSON & MORELAND
Engineers and Consultants
Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine Design—Technical Publications
Boston — New York

METCALF & EDDY
Engineers
Investigations — Reports — Design
Supervision of Construction and Operation
Management — Valuation — Laboratory
Statler Building, Boston 16

BENJAMIN S. SHEINWALD
Architectural Consultants on Engineering Projects
Design—Supervision—Reports
85 South Street, Boston 11, Mass.

Clark Aerial Survey Corporation
Topographic Maps—Mosaics—Reconnaissance Strips
E. W. Clark, President
43075 N. Territorial Rd — Plymouth, Michigan

BLACK & VEATCH
Consulting Engineers
Water—Sewage—Electricity—Industry
Reports, Design Supervision of Construction Investigations, Valuation and Rates
4706 Broadway — Kansas City 2, Mo.

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City 2, Mo. — Cleveland 14, Ohio
P. O. Box 7088 — 1404 E. 9th St.

SVERDRUP & PARCEL, INC.
Consulting Engineers
Bridges, Structures and Reports
Industrial and Power Plant Engineering
Syndicate Trust Bldg., St. Louis 1, Mo.
220 Bush Street, San Francisco 4, Cal.

A. L. ALIN
Consulting Engineer
5927 N. 24 St.
Omaha, Nebraska
Dams, Hydroelectric Power
Flood Control

EDWARDS, KELCEY AND BECK
Consulting Engineers
Surveys—Reports—Economic Studies—Transportation, Traffic — Design — Supervision — Management — Port and Harbor Works—Terminals—Expressways — Highways — Grade Separations — Bridges—Tunnels—Water Supply
3 William Street — 250 Park Avenue
Newark 2, N. J. — New York 17, N.Y.

PORTER-URQUHART ASSOCIATED
O. J. Porter & Co.
Consulting Engineers
Airports—Highways—Dams
Foundations—Stabilization—Pavements
415 Frelinghuysen Ave., Newark 5, N.J.
79-Ninth Ave., New York 11, N.Y.

CHARLES DOHN, P. E.
Appointments Invited
Mail Inquiry Only
70-41 67th Place, Glendale, L. I, N. Y.

AMMANN & WHITNEY
Consulting Engineers
Design — Construction Supervision
Bridges, Buildings, Industrial Plants, Special Structures, Foundations, Airport Facilities
Expressways
76 Ninth Avenue, New York 11, N. Y.
724 E. Mason Street, Milwaukee 2, Wis.

CLINTON L. BOGERT ASSOCIATES
Consulting Engineers
Clinton L. Bogert — Ivan L. Bogert
J. M. Greig — Robert A. Lincoln
Donald M. Dimmers — Arthur P. Ackerman
Water and Sewage Work
Refuse Disposal — Industrial Wastes
Drainage — Flood Control
624 Madison Avenue, New York 22, New York

BOWE, ALBERTSON & ASSOCIATES
Engineers
Water and Sewage Works
Industrial Wastes—Refuse Disposal—Municipal Projects
Airfields—Industrial Buildings
Reports—Designs—Estimates
Valuations—Laboratory Service
110 William St., New York 7, N. Y.

FRANK L. EHASZ
Consulting Engineer
Structures, Bridges, Airports, Parkways
Design Supervision of Construction
Investigations, Reports
730 Fifth Avenue — New York 19, N.Y.

HARDESTY & HANOVER
Consulting Engineers
Long Span and Movable Bridges, Hanover Skew Bascule, Grade Eliminations, Foundations, Other Structures, Supervision, Appraisals, and Reports.
101 Park Avenue, New York 17, N. Y.

FREDERIC R. HARRIS, INC.
Consulting Engineers
Harbors, Piers & Bulkheads, Drydocks, Foundations, Soil Mechanics, Industrial Plants, Water Supply, Flood Control, Airports, Highways, Bridges, Power, Sanitary & Industrial Waste Disposal
27 William Street — New York 5, N. Y.
3 William Street — Newark, N. J.
Fidelity Phila. Trust Bldg., Philadelphia
Ferry Building — San Francisco

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
Consulting Engineers
Bridges, Structures, Foundations
Express Highways
Administrative Services
921 Walnut Street — 55 Liberty Street
Kansas City 6, Mo. — New York 5, N. Y.

KNAPPEN-TIPPETTS-ABBETT MCCARTHY
Engineers
Ports, Harbors, Flood Control Irrigation Power, Dams, Bridges, Tunnels, Highways
Subways, Airports, Traffic, Foundations, Water Supply, Sewerage, Reports, Design, Supervision, Consultation
62 West 47th Street, New York City

LEGGETTE & BRASHEARS
Consulting Ground Water Geologists
Water Supply, Salt Water Problems, Dewatering, Recharging, Investigations, Reports.
551 Fifth Avenue, New York 17, N. Y.

MORAN, PROCTOR, MUESER & RUTLEDGE
Consulting Engineers
Foundations for Buildings, Bridges and Dams, Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests, Reports, Design and Supervision.
420 Lexington Ave., New York 17, N. Y.
AP. Cor. 614, Caracas, Venezuela

PARSONS, BRINCKERHOFF HALL & MACDONALD
Engineers
Bridges, Highways, Tunnels, Airports, Traffic and Transportation Reports, Subways, Harbor Works, Dams, Canals, Power Projects, Industrial Buildings, Housing, Sewerage and Water Supply.
51 Broadway — New York 6, N. Y.

MALCOLM PIRNIE ENGINEERS
Civil & Sanitary Engineers
Malcolm Pirnie — Ernest W. Whitlock
Robert D. Mitchell — Carl A. Arenander
Malcolm Pirnie, Jr.
Investigations, Reports, Plans
Supervision of Construction and Operations
Appraisals and Rates
25 W. 43rd Street, New York 36, N. Y.

THE PITOMETER CO.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement and Special Hydraulic Investigations
New York, 50 Church St.

ALEXANDER POTTER ASSOCIATES
Consulting Engineers
Water Works, Sewerage, Drainage. Refuse Incinerators, Industrial Wastes, City Planning
50 Church Street, New York 7, N. Y.

THE PRELOAD COMPANY, INC.
Engineers in Prestressed Design
211 East 37th Street
New York 16, N. Y.

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Manufacturing Plants
Heavy Engineering
Structural
Mechanical
101 Park Ave., New York 17, N. Y.

SEVERUD-ELSTAD-KRUEGER
Consulting Engineers
Structural Design—Supervision—Reports
Buildings—Airports—Special Structures
415 Lexington Ave., New York 17, N. Y

SINGSTAD & BAILLIE
Consulting Engineers
Ole Singstad — David G. Baillie, Jr
Tunnels, Subways, Highways, Foundations, Parking Garages
Investigations, Reports Design, Specifications, Supervision
24 State St. — New York 4, N. Y

FREDERICK SNARE CORPORATION
Engineers-Contractors
Harbor Works, Bridges, Power Plant Dams, Docks and Foundations
233 Broadway, New York 7, N. Y
Santiago, Chile — San Juan, P. R
Havana, Cuba — Lima, Peru
Bogota, Colombia — Caracas, Venezuela

D. B. STEINMAN
Consulting Engineer
BRIDGES
Design, Construction, Investigation, Reports, Strengthening, Advisory Service
117 Liberty Street, New York 6, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design, Construction, Reports, Appraisals
Eighty Broad Street, New York 4, N. Y

JAMES M. CAIRD
Established 1898
C. E. Clifton, H. A. Bennett
Chemist and Bacteriologist
Water Analysis
Tests of Filter Plants
Cannon Building, Troy, N. Y.

Additional Professional Cards On The Preceding Page

Professional Services

Listed alphabetically by states

More and More Members of the Society are using this Service. Is Your Card Here?

THE AUSTIN COMPANY
Design — Construction — Reports
Plant Location Surveys—Domestic & Foreign Work
16112 Euclid Avenue, Cleveland, Ohio
New York Detroit Oakland
Chicago Houston Seattle
Los Angeles

HAVENS AND EMERSON
W. L. Havens C. A. Emerson
A. A. Burger F. C. Tolles F. W. Jones
W. L. Leach H. H. Moseley
J. W. Avery
Consulting Engineers
Water, Sewerage, Garbage, Industrial Wastes, Valuations—Laboratories
Leader Bldg. Woolworth Bldg.
Cleveland 14, O. New York 7, N. Y.

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
HARRISBURG, PA.
Water Works, Sewage, Industrial Wastes & Garbage Disposal—Roads, Airports, Bridges & Flood Control, City Planning, Traffic & Parking, Appraisals, Investigations & Reports.
Branch Offices
Scranton, Pa. Pittsburgh, Pa.
Daytona Beach, Fla.
Medellin, Colombia, S.A.

MODJESKI AND MASTERS
Consulting Engineers
F. M. Masters
G. H. Randall J. R. Glase
C. W. Hanson H. J. Engel
Design and Supervision of Construction
Inspection and Reports
Bridges, Structures and Foundations
535 Fifth Ave. State St. Bldg.
New York, N. Y. Harrisburg, Pa.

ALBRIGHT & FRIEL, INC.
Consulting Engineers
Francis S. Friel
Water, Sewage and Industrial Waste Problems, Airfields, Refuse Incinerators, Dams, Flood Control, Industrial Buildings, City Planning, Reports, Valuations—Laboratory
121 So. Broad Street, Philadelphia 7, Pa.

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin Neville C. Courtney
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St., Philadelphia 7, Pa.

G. G. GREULICH
Consulting Engineer
Investigations, Reports, Advice.
Pile Foundations, Sheet Piling, Cofferdams, Bulkheads, Piers, Bridge Decks, Bank Vaults.
1346 Connecticut 778 Osage Road
Washington 6, D.C. Pittsburgh 16, Pa.

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants — Warehouses — Commercial Buildings—Steel and Reinforced Concrete—Design—Supervision—Reports
1150 Century Bldg., Pittsburgh 22, Pa.

MORRIS KNOWLES INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposal
Valuations, Laboratory, City Planning
1312 Park Bldg., Pittsburgh 22, Pa.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Surveys—Design—Supervision
Domestic and Foreign
Industrials and Utilities
412 Washington Street, Reading, Pa.

MICHAEL BAKER, JR., INC.
The Baker Engineers
Civil Engineers, Planners, and Surveyors
Airports—Highways—Sewage Disposal Systems—Water Works Design and Operation—City Planning—Municipal Engineering—All Types of Surveys
Home Office: Rochester, Pa.
Branch Offices:
Jackson, Miss. Harrisburg, Pa.

R. C. JOHNSON
Consulting and Designing Engineer
1226 Bull St., Columbia 1, S. C.

WHITE, GUYTON AND BARNES
Consulting Ground-Water Hydrologists
Ground-Water Supplies
Evaluation, Planning of New Developments, Operational and Maintenance Advice, Legal Proceedings, Artificial Recharge, Induced River Infiltration, Well Interference and Other Ground-Water Problems.
307 W. 12th St., Austin 1, Texas
Tel. 7-7165

GREER & MCCLELLAND
Consulting Foundation Engineers
Foundation investigations — engineering soil testing — undisturbed sampling and core drilling.
2649 N. Main Houston 9, Texas
98 Greenwood Ave., Montclair, N. J.

LOCKWOOD & ANDREWS
Consulting Engineers
Industrial Plants, Harbors, Public Works, Roads, Airports, Structures, Earthworks
Mechanical & Electrical
Reports—Design—Supervision
Surveys—Valuations
HOUSTON—VICTORIA

Preserve your
PROCEEDINGS-SEPARATES OR MANUALS
in special
MULTIPLE BINDERS
available now in two forms

Style 1

for Proceedings-Separates—holds thirty individual leaflets securely with wire inserts, easy to install or remove.

Style 2

for Manuals of Engineering Practice—has room for fifteen pamphlets, attached by wire holders.

These binder covers are designed for easy assembly or re-assembly and repeated use of reference material. They are in substantial black fabricoid with gold lettering, and are stable and useful when partially or completely full.

Order form

American Society of Civil Engineers
33 West 39th St., New York 18, N.Y.

Enclosed is $.....in payment for.....Proceedings-Separates Binders (Style 1) at $2.25 each.....
Manuals Binders (Style 2) at $2.25 each.....
Date Total

Name.....

Membership Grade.....

Address.....

NOW AVAILABLE
GLOSSARY: WATER AND SEWAGE CONTROL ENGINEERING

A Wealth of Engineering Terms, 276 pages with 4,200 Definitions and Cross References

Price $2.00

(50% discount to members for first copy)

A limited number of cloth bound copies available at only $1.00 extra per copy.

SEND AT ONCE USING THE COUPON BELOW

American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.

Please forward "GLOSSARY: Water and Sewage Control Engineering," as indicated.

☐ .....copies paper covered at $2.00
☐ one copy only " " " 1.00 (To Members)
☐ .....copies cloth bound at $3.00
☐ one copy only " " " 2.00 (To Members)

Payment is enclosed herewith

Name.....

Grade Membership.....

Address.....

City.....

Index to Advertisers

Allis-Chalmers Manufacturing Company . . . . . 82 and 83
American Bitumuls & Asphalt Company 6
American Cast Iron Pipe Company 7
American Manganese Bronze Company 109
Armco Drainage & Metal Products Corp. 8
Austin-Western Company 21

Barber-Greene Company 1
Boeing Airplane Company 105
Brown & Brown, Incorporated 118
Bucyrus-Erie Company 11

Cast Iron Pipe Research Association . . . . . 4 and 5
Caterpillar Tractor Co. 9
Cement Gun Company 113
Chicago Bridge & Iron Company 24

Drilled-In Caisson Corporation 110

Eastman Kodak Company 81
Economy Forms Corp. 116

W. & L. E. Gurley 89

Imperial Pencil Tracing Cloth 114
International Harvester Company . . . . . 12 and 13
Irving Subway Grating Co., Inc. 17

Johns-Manville Corporation . . . . . 14 and 15

Keuffel & Esser Co. 114
Koppers Company, Inc. 116

Layne & Bowler, Incorporated 18
Lefax 118
The James Leuffel & Co. 3
Leupold & Stevens Instruments Inc. 117
The Lincoln Electric Company 75
Lockheed Aircraft Corporation 103
Lock Joint Pipe Company . . . . . 4th cover
Lone Star Cement Corporation 22

MacArthur Concrete Pile Corp. 117
The Master Builders Co. . . . . 3rd cover
Moretrench Corporation 115

Naylor Pipe Company 99

Pennsylvania Drilling Co. 118
Pittsburgh-Des Moines Steel Co. 10
Portland Cement Association 16
Pressure Concrete Company 116

Raymond Concrete Pile Co. . . . . 2nd cover

Servicised Products Corporation 124
A. O. Smith Corporation 115
Spencer, White & Prentis, Inc. 113
Sprague & Henwood, Inc. 117
John W. Stang Corporation 109

The Texas Company 19
Timber Structures, Inc. 101

Union Metal Manufacturing Company 2
U. S. Pipe & Foundry Company 20

Viber Company 98

Wallace & Tiernan Products Inc. 109
Warren Foundry & Pipe Company 107
David White Company 111
Henry Wild Surveying Instrument Supply Co. 114
R. D. Wood Company 106

Yuba Manufacturing Co. 118

Professional Services . . . . . 121, 122 and 123

Servicised
PREMOLDED
Para-Plastic*
FOR EFFECTIVE
JOINT SEALING
PARALATERAL Wide Strip
For sealing vertical construction or expansion joints in Retaining Walls, Abutments, Wing Walls, Foundations, etc., particularly when one side will be backfilled and protection from water seepage is necessary. Has rigid backing of asphalt joint material and surface and both edges coated with Para-Plastic, which mainfains bond with concrete at all times.
MOLDED STRIP
Para-Plastic Sealing Compound is molded into strips for sealing of keyed construction joints and cracks or breaks in vertical concrete surfaces. Concrete poured against the strip, after setting up, will bond with strip to form watertight seal.
NARROW STRIP Pressure Seal
Para-Plastic Pressure Seal is available in both Solid Para-Plastic, and Para-Plastic coated sponge rubber types which are rectangular or square in cross section. Designed for sealing existing expansion joints or contraction cracks in vertical or sloping masonry walls and surfaces.
Servicised Engineers are available for consultation on your joint sealing problems. Write for details and specification data. There is no obligation.
*Para Plastic is one of the many patented products developed for the Construction Industry by Servicised Products Corp.
SERVICISED PRODUCTS CORP.
6051 W. 65th STREET • CHICAGO 38, ILL.

Masterbuilt Floor in Hinde & Dauch Paper Co. Box Plant, Richmond, Va. Archt.—Carneal & Johnston; General Contr.—Doyle & Russell—both of Richmond, Va.; Floor Contr.—The Vannier Co., Buffalo, N. Y.

4-6 Times Longer Floor Life with the MASTERPLATE "Iron-Clad" Concrete Floor

The good performance of Masterbuilt iron armored concrete floors in two other Hinde & Dauch plants resulted in the company's decision to install this modern industrial floor in the fine new plant shown above.

Long floor life — 4 to 6 times greater than the best plain concrete floor — is only one of the reasons why many million square feet of Masterplate Floors have been installed in plants of all types during the past twenty years.

In addition to great wear resistance, Masterplate Floors have the following advantages:

- SPARK RESISTANT†
- NON-SLIP FINISH
- NON-DUSTING
- EASY-TO-CLEAN
- CORROSION RESISTANT
- BUILT-IN-COLOR — NON-COLORED AND 11 ATTRACTIVE COLORS
- LOW COST

† spark-safe floor with 1.0 to 1.25 lbs. Masterplate per square foot of floor.

These advantages of the Masterplate Floor result from the *thick* iron-concrete armorplate produced by embedding specially processed, size-graded iron particles, combined with Master Builders' cement dispersing agent, in the *surface* of concrete while still in a plastic condition.

Ask for full information and pictorial directions on Masterplate for new floors and resurfacing old concrete floors; also free floor survey.

The MASTER BUILDERS Co.

VELAND 3, OHIO — Subsidiary of American-Marietta Company — TORONTO, ONTARIO

LOCK JOINT

...in the heart of the GREAT LAKES REGION

SERVICE TO THE HIGHLY INDUSTRIALIZED GREAT LAKES REGION is the main purpose of Lock Joint's permanent manufacturing plant on the outskirts of Detroit. Specializing in pipe 24" in diameter and larger for water supply lines, distribution feeder mains, cooling water or process water lines, subaqueous intakes and outfalls, the Detroit plant is ideally situated to serve such nearby industrial centers as Chicago, Cleveland, Gary, Akron and Toledo. Because of this convenient location, pipe from the Detroit plant can be economically shipped to other parts of the country, as well.

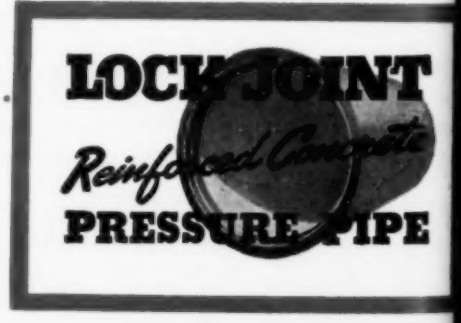
AUGMENTING THE DETROIT OPERATION are our three other modern permanent pipe manufacturing plants. Each of these plants is strategically located to serve the rest of the country East of the Rockies. The Wharton, N. J., plant covers the East; Columbia, S. C., the South; and Turner, Kansas, the Great Plains. No matter how large or small your contracts may be, if your pipe requirements are 16" in diameter or larger, you can rest assured that the efficient and economical answer to your pipe problem can be supplied from one of these four Lock Joint Plants.

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

BRANCH OFFICES: Casper, Wyo. • Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. • Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. Kenilworth, N. J. • Hartford, Conn. • Tucumcari, N. Mex. • Oklahoma City, Okla. • Tulsa, Okla. • Beloit, Wis. • Hato Rey, P. R. • Caracas, Venezuela